TESTIMONY OF BARRY LOGAN

SEPTEMBER 9, 2004

DEMARRE ORIGINAL EXHIBITS

NO. 1 THROUGH 47

EXHIBIT 3

SIMULATOR THERMOMETER CERTIFICATION

I, Barry K. Logan, certify under penalty of perjury under the laws of the State of Washington that the following is true and correct:

I am the State Toxicologist authorized under RCW 46.61.506 to approve methods for breath alcohol testing within the State of Washington.

The mercury-in-glass thermometer with a scale graduated in tenths of a degree measuring a range between 33.5 to 34.5 degrees centigrade, as approved in WAC 448-13-020, is the only thermometer employed within simulator devices attached to BAC DataMasters.

EXECUTED this 10th day of June, 2004, at Seattle, Washington.

Dr. Barry K. Logan, State Toxicologist

Demarre
EXHIBIT NO. 1
9-9-04
M. Green

EXHIBIT 4

NIST TRACEABILITY DECLARATION

I, Barry K. Logan, declare under penalty of perjury under the laws of the State of Washington that the following is true and correct:

I am the State Toxicologist authorized under RCW 46.61.506 to approve methods for breath alcohol testing within the State of Washington.

As early as March 19, 2003, and in no case later than December 12th, 2003, the simulator solution thermometers used in DataMaster instruments for breath testing in the State of Washington have been tested and certified against thermometers traceable to standards maintained by NIST. The uncertainties have been measured and recorded at each level. They are in compliance with the requirements of NIST traceability. The documents used by the Washington State Patrol to support NIST traceability are public record and may be found at www.breathtest.wsp.wa.gov or at the Washington State Patrol Breath Test Section, 811 E. Roanoke, Seattle, Washington. Additional information can be obtained at (206) 720-3018.

Dr. Barry K. Logan, State Toxicologist

Dated: July 13, 2004

Location: Seattle WA (city and state)

To drivers and attorneys: This exhibit will be used for your upcoming DOL hearing, as noted on the enclosed scheduling letter.

Demarre
EXHIBIT NO. 2
9-9-04
M. Green

EXHIBIT 3

SIMULATOR SOLUTION THERMOMETER ANNUAL CERTIFICATION AND NIST TRACEABILITY DECLARATION

I, Barry K. Logan, declare under penalty of perjury under the laws of the State of Washington that the following is true and correct:

I am the State Toxicologist authorized under RCW 46.61.506 to approve methods for breath alcohol testing within the State of Washington.

All simulator solution thermometers used in the Datamaster instruments have been certified on an annual basis to have an accuracy of within plus or minus 0.1 degrees centigrade. By December 12, 2003, the simulator solution thermometers used in all DataMaster instruments for breath testing in the State of Washington had been tested and certified against thermometers traceable to standards maintained by NIST. The uncertainties have been measured and recorded at each level. They are in compliance with the requirements of NIST traceability The documents used by the Washington State Patrol to support NIST traceability are public record and may be found at www.breathtest.wsp.wa.gov or at the Washington State Patrol Breath Test Section, 811 E. Roanoke, Seattle, Washington. Additional information can be obtained at (206) 720-3018.

Dr. Barry K. Logan, State Toxicologist

Dated: August 4th, 2004

Location: Seattle, WA (city and state)

To drivers and attorneys: This exhibit will be used for your upcoming DOL hearing, as noted on the enclosed scheduling letter.

Demarre
EXHIBIT NO. 3
9-9-04
M. Green

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Fax: 772 286 8737 E-mail: jeff@iclabs.com
Internet: www.iclabs.com
Field office: Caguas, PR Tel: 787 286 7446

CERT # 526.01

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 01-21-2004

INSTRUMENT DESCRIPTION:

Serial No: 091800 Inscription: GUTH LABS INC. Date report issued: 01-22-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

NOTE: Battery checked prior to calibration and is in satisfactory state of charge.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.01°C	33.01°C	-0.01°C	0.023°C
34.00°C	34.01°C	34.01°C	-0.01°C	0.023°C
35.00°C	35.01°C	35.01°C	-0.01°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/-0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

Demarre
EXHIBIT NO. 4
9-9-04
M. Green

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH

ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: J. JEFF KELLY

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 0159, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06
TEMP: 34.00°C Reference: NIST SPRT S/N 0159, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06
TEMP: 35.00°C Reference: NIST SPRT S/N 0159, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A HART SCIENTIFIC MODEL 5699 25.5 OHM SPRT, CALIBRATED BY NIST IN OCTOBER, 2003. NIST GMP-11 SPECIFIES A THREE YEAR CALIBRATION INTERVAL FOR SPRTs. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JANUARY OF 2004, AND ARE ON A SIX MONTH CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to 0.01C: +/- 0.00015C; 0.01C: +/- .00002C; >0 to 231.928C: +/- 0.00024C; >231.928C to 419.527C: +/- 0.00041C.

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 01-22-2004 RECOMMENDED RECALIBRATION DATE: January 22, 2005

NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-

REPORT OF CALIBRATION

International Temperature Scale of 1990

Standard Platinum Resistance Thermometer
Hart Scientific Model 5699
Serial Number 0159

Submitted by:
ICL Calibration Laboratories, Inc.
Stuart, FL 34994

This standard platinum resistance thermometer (SPRT) was calibrated with an AC bridge operating at a frequency of 30 Hz and with continuous measuring currents of 1.0 mA and 1.414 mA. In accordance with the International Temperature Scale of 1990 (ITS-90) that was officially adopted by the Comite´ International des Poids et Mesures (CIPM) in September 1989, the subranges from 83.8058 K to 273.16 K and 273.15 K to 692.677 K, with the following fixed points and their stated expanded uncertainties ($k = 2$), were used to calibrate the thermometer. For a description of the uncertainties, see NISTIR 5319, 16 pp., (1994), entitled "*Assessment of Uncertainties of Calibration of Resistance Thermometers at the National Institute of Standards and Technology.*"

Fixed Point		Temperature T_{90} (K)	Temperature t_{90} (°C)	Expanded Uncertainty where $k = 2$ (mK)
Ar	TP	83.8058	−189.3442	0.08
Hg	TP	234.3156	−38.8344	0.15
H_2O	TP	273.16	0.01	0.02
Sn	FP	505.078	231.928	0.24
Zn	FP	692.677	419.527	0.41

The following values were determined for the coefficients of the pertinent deviation functions of the ITS-90, as given in the attached material describing the scale. The attached tables were generated using these values.

Coefficients for Zero-Power Dissipation Calibration				Coefficients for 1 mA Calibration			
$a_4 =$	−8.1949689E-05	$a_8 =$	−1.0087772E-04	$a_4 =$	−8.4240654E-05	$a_8 =$	−1.0147545E-04
$b_4 =$	−1.6559779E-06	$b_8 =$	−7.2796096E-06	$b_4 =$	−2.3376083E-06	$b_8 =$	−7.7646210E-06

The resistance of this thermometer at 273.16 K was calculated to be 25.4670 Ω at zero-power dissipation and 25.4670 Ω at 1 mA. During calibration, the resistance at 273.16 K changed by the equivalent of 0.3 mK at zero-power dissipation and 0.3 mK at 1 mA.

This thermometer is satisfactory as a defining instrument of the ITS-90 in accordance with the criteria that W(302.9146 K) ≥ 1.118 07 or W(234.3156 K) ≤ 0.844 235.

For the Director,
National Institute of Standards and Technology

Dean Ripple

Dean C. Ripple
Leader, Thermometry Group
Process Measurements Division

Demarre
EXHIBIT NO. 5
9-9-04
M. Green

October 7, 2003
Test No.: 836/269257-03
Purchase Order No.: 68157

NIST

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ACCREDITED CERT. # 526.01

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 6
9-9-04
M. Green

ACCREDITED TO ISO/IEC 17025 and ANSI/NCSL Z540-1 — NIST TRACEABLE — ICL CALIBRATION LABORATORIES, INC.

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 02-16-2004

INSTRUMENT DESCRIPTION:

Serial No: 082709 Inscription: GUTH LABS INC. Date report issued: 02-23-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

NOTE: UUT was received with a low battery. A new 9 volt battery was installed prior to calibration.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.01°C	33.01°C	-0.01°C	0.023°C
34.00°C	34.01°C	34.01°C	-0.01°C	0.023°C
35.00°C	35.01°C	35.01°C	-0.01°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH

ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and comparator(s) utilized in the performance of this calibration are listed below:

Our NIST primary reference thermometer from -196 to 420C is a Hart Scientific model# 5699, 25.5 Ohm SPRT, serial no. 0159, calibrated by NIST on October 7, 2003. NIST GMP-11 recommends a 36 month calibration cycle for SPRTs. Transfer standards PRTs are calibrated against this reference standard semi-annually; ASTM liquid-in-glass transfer standards are calibrated annually. Our primary reference thermometer for temperatures from 420 to 1000C is a Hart Scientific Type 'S' thermocouple sensor, serial no. 9112, calibrated by Hart Scientific on January 13, 2003. This standard is on a 24 month calibration cycle.

Test Point	Comparator	MTE#	Manufacturer	Transfer Standard	MTE#	Manufacturer	Next Due
33.00°C	7310 Water bath	012	Polyscience	5614 PRT	127	Hart Scientific	07/16/04
34.00°C	7310 Water bath	012	Polyscience	5614 PRT	127	Hart Scientific	07/16/04
35.00°C	7310 Water bath	012	Polyscience	5614 PRT	127	Hart Scientific	07/16/04

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 02-23-2004 RECOMMENDED* RECALIBRATION DATE: February 23, 2005

*NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available for download in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

*The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for liquid-in-glass thermometers (see section 8.3) and for portable electronic thermometers (PETs). See section 8.2

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
Members: **ASTM NCSL ASQ NCWM**

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Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com
Field office: Caguas, PR Tel: 787 286 7448

ACCREDITED CERT # 526.01

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

CUSTOMER INFORMATION:

Demarre
EXHIBIT NO. 7
9-9-04
M. Green

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 07-10-2003

ACCREDITED TO ISO/IEC 17025 and ANSI/NCSL Z 540-1 ICL CALIBRATION LABORATORIES, INC. NIST TRACEABLE

INSTRUMENT DESCRIPTION:

Serial No: 082709 Inscription: GUTH LABS INC. Date report issued: 07-11-2003 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.00°C	33.00°C	0.00°C	0.023°C
34.00°C	34.00°C	34.00°C	0.00°C	0.023°C
35.00°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: J. JEFF KELLY

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 537360 Comparator: PolyScience water bath MTE-06
TEMP: 34.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 537360 Comparator: PolyScience water bath MTE-06
TEMP: 35.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 537360 Comparator: PolyScience water bath MTE-06

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN APRIL, 2002. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JANUARY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2002 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

Kelly

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 07-11-2003 RECOMMENDED RECALIBRATION DATE: July 11, 2004

NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'.
Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals.
Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals.
NIST GMP-11 is available for viewing in .pdf format on our website at www.icllabs.com Follow the link for 'How often should I recalibrate...?

The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
Members: **ASTM NCSL ASQ NCWM**
Setting new standards in calibration excellence!

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Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com
Field office: Caguas, PR Tel: 787 286 7448

ACCREDITED CERT # 526.01

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

CUSTOMER INFORMATION:

Demarre
EXHIBIT NO. 8
9-9-04
M. Green

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 02-16-2004

INSTRUMENT DESCRIPTION:

Serial No: 082709 Inscription: GUTH LABS INC. Date report issued: 02-23-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

NOTE: UUT was received with a low battery. A new 9 volt battery was installed prior to calibration.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.01°C	33.01°C	-0.01°C	0.023°C
34.00°C	34.01°C	34.01°C	-0.01°C	0.023°C
35.00°C	35.01°C	35.01°C	-0.01°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH

ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and comparator(s) utilized in the performance of this calibration are listed below:

Our NIST primary reference thermometer from -196 to 420C is a Hart Scientific model# 5699, 25.5 Ohm SPRT, serial no. 0159, calibrated by NIST on October 7, 2003. NIST GMP-11 recommends a 36 month calibration cycle for SPRTs. Transfer standards PRTs are calibrated against this reference standard semi-annually; ASTM liquid-in-glass transfer standards are calibrated annually. Our primary reference thermometer for temperatures from 420 to 1000C is a Hart Scientific Type 'S' thermocouple sensor, serial no. 9112, calibrated by Hart Scientific on January 13, 2003. This standard is on a 24 month calibration cycle.

Test Point	Comparator	MTE#	Manufacturer	Transfer Standard	MTE#	Manufacturer	Next Due
33.00°C	7310 Water bath	012	Polyscience	5614 PRT	127	Hart Scientific	07/16/04
34.00°C	7310 Water bath	012	Polyscience	5614 PRT	127	Hart Scientific	07/16/04
35.00°C	7310 Water bath	012	Polyscience	5614 PRT	127	Hart Scientific	07/16/04

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 02-23-2004 RECOMMENDED* RECALIBRATION DATE: February 23, 2005

**NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available for download in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.*

**The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for liquid-in-glass thermometers (see section 8.3) and for portable electronic thermometers (PETs). See section 8.2*

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

CERT. # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
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Fax: 772 286 8737 E-mail: sales@icllabs.com
Internet: www.icllabs.com

Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, (WHICH SUPERCEDED AND REPLACED MIL-STD 45662A), AND THE ISO-9000 AND QS-9000 SERIES OF QUALITY STANDARDS.

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

Demarre
EXHIBIT NO. 9
9-9-04
M. Green

ISO/IEC 17025 and ANSI/NCSL ... NIST TRACEABLE ... CALIBRATION LABORATORIES

PURCHASE ORDER NUMBER: NOT AVAILABLE

SUBMITTED BY: WASHINGTON STATE PATROL

DATE RECEIVED FOR CALIBRATION: 07-14-2004

INSTRUMENT DESCRIPTION:

Serial No: 091793 Inscription: GUTH LABS INC. Date report issued: 07-21-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 ACCURACY TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.000°C	33.01°C	33.01°C	-0.01°C	0.023°C
34.000°C	34.01°C	34.01°C	-0.01°C	0.023°C
35.000°C	35.01°C	35.01°C	-0.01°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

This calibration is traceable to NIST through a direct chain of comparisons.

The NIST primary reference standard(s), transfer standard(s) and comparator(s) utilized in the performance of this calibration are listed below:

Our NIST primary reference thermometer from -196 to 420C is a Hart Scientific model# 5682, 100 Ohm SPRT, serial no. 1035, calibrated by NIST on July 11, 2003. NIST GMP-11 recommends a 36 month calibration cycle for SPRTs. Transfer standards PRTs are calibrated against this reference standard semi-annually; ASTM liquid-in-glass transfer standards are calibrated annually.

Our primary reference thermometer for temperatures from 420 to 1000C is a Hart Scientific Type 'S' thermocouple sensor, serial no. 9112, calibrated by Hart Scientific on January 13, 2003. This standard is on a 24 month calibration cycle.

Test Point	Comparator	MTE#	Manufacturer	Transfer Standard	MTE#	Manufacturer	Next Due
33.000°C	7310 water bath	012	Polyscience	5614 PRT 597010	135	Hart Scientific	01/17/05
34.000°C	7310 water bath	012	Polyscience	5614 PRT 576776	130	Hart Scientific	01/17/05
35.000°C	7310 water bath	012	Polyscience	5614 PRT 576776	130	Hart Scientific	01/17/05

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 07-21-2004 *RECOMMENDED* RECALIBRATION DATE: July 21, 2005*

**NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available for download in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.*

**The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for liquid-in-glass thermometers (see section 8.3) and for portable electronic thermometers (PETs). See section 8.2*

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

ACCREDITED CERT # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
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REPORT OF TEST FOR DIGITAL THERMOMETER

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CUSTOMER INFORMATION:

Demarce
EXHIBIT NO. 10
9-9-04
M. Green

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 08-08-2003

ISO/IEC 17025 and ANSI/NCSL Z540-1 NIST TRACEABLE CALIBRATION LABORATORIES, INC.

INSTRUMENT DESCRIPTION:

Serial No: 091793 Inscription: GUTH LABS INC. Date report issued: 08-14-2003 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.01°C	33.01°C	-0.01°C	0.023°C
34.00°C	34.01°C	34.01°C	-0.01°C	0.023°C
35.00°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: J. JEFF KELLY

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06
TEMP: 34.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06
TEMP: 35.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN JULY, 2003. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JULY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2003 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

Deborah M. Weber

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 08-14-2003 RECOMMENDED RECALIBRATION DATE: August 14, 2004

NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'.
Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals.
Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals.
NIST GMP-11 is available in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
Members: **ASTM NCSL ASQ NCWM**
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ACCREDITED CERT # 526.01

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Internet: www.icllabs.com
Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 11
9-9-04
M. Green

Accredited to ISO/IEC 17025 and ANSI/NCSL Z 540-1
NIST TRACEABLE
ICL CALIBRATION LABORATORIES, INC.

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 01-05-2004

INSTRUMENT DESCRIPTION:

Serial No: 091794 ID #6801 Inscription: GUTH LABS INC. Date report issued: 01-06-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.00°C	33.00°C	0.00°C	0.023°C
34.00°C	34.00°C	34.00°C	0.00°C	0.023°C
35.00°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: J. JEFF KELLY

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06
TEMP: 34.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06
TEMP: 35.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN JULY, 2003. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JULY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2003 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

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Deborah M. Weber

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DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 01-06-2004 RECOMMENDED RECALIBRATION DATE: January 06, 2005

NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

CERT # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
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Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 12
9-9-04
M. Green

Accredited to ISO/IEC 17025 and ANSI/NCSL Z540-1
NIST TRACEABLE
ICL CALIBRATION LABORATORIES, INC.

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 04-14-2003

INSTRUMENT DESCRIPTION:

Serial No: 091794 Inscription: GUTH LABS INC. Date report issued: 04-15-2003 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.00°C	33.00°C	0.00°C	0.023°C
34.00°C	34.00°C	34.00°C	0.00°C	0.023°C
35.00°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODOLOGY ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 DOCUMENT ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: J. JEFF KELLY

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-06
TEMP: 34.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-06
TEMP: 35.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-06

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN APRIL, 2002. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JANUARY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2002 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 04-15-2003 RECOMMENDED RECALIBRATION DATE: April 15, 2004

NBS GMP-11, 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values.' GMP-11, P4 recommends recalibration of liquid-in-glass thermometers and 100 ohm PRTs at 6 month intervals for 'Temperature Critical Parameters', or 12 month intervals for thermometers used for 'Secondary Parameters'.
The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
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Tel: 772 286 7710 1-800-713-6647
Fax: 772 286 8737 E-mail: sales@icllabs.com
Internet: www.icllabs.com

Field office: Cagues, PR Tel: 787 286 7448

CERT. # 528.01

REPORT OF TEST FOR DIGITAL THERMOMETER

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CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

Demarre
EXHIBIT NO. 13
9-9-04
M. Green

Accredited to ISO/IEC 17025 and ANSI/NCSL Z 540-1
NIST TRACEABLE
ICL CALIBRATION LABORATORIES, INC.

PURCHASE ORDER NUMBER: NOT AVAILABLE

SUBMITTED BY: WASHINGTON STATE PATROL

DATE RECEIVED FOR CALIBRATION: 08-10-2004

INSTRUMENT DESCRIPTION:

Serial No: 091794 ID #6801 Inscription: GUTH LABS INC. Date report issued: 08-18-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 ACCURACY TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.000°C	33.00°C	33.00°C	0.00°C	0.023°C
34.000°C	34.01°C	34.01°C	-0.01°C	0.023°C
35.000°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: J. JEFF KELLY

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

This calibration is traceable to NIST through a direct chain of comparisons.

The NIST primary reference standard(s), transfer standard(s) and comparator(s) utilized in the performance of this calibration are listed below:

Our NIST primary reference thermometer from -196 to 420C is a Hart Scientific model# 5682, 100 Ohm SPRT, serial no. 1035, calibrated by NIST on July 11, 2003. NIST GMP-11 recommends a 36 month calibration cycle for SPRTs. Transfer standards PRTs are calibrated against this reference standard semi-annually; ASTM liquid-in-glass transfer standards are calibrated annually.

Our primary reference thermometer for temperatures from 420 to 1000C is a Hart Scientific Type 'S' thermocouple sensor, serial no. 9112, calibrated by Hart Scientific on January 13, 2003. This standard is on a 24 month calibration cycle.

Test Point	Comparator	MTE#	Manufacturer	Transfer Standard	MTE#	Manufacturer	Next Due
33.000°C	7310 water bath	012	Polyscience	5614 PRT 524105	127	Hart Scientific	01/17/05
34.000°C	7310 water bath	012	Polyscience	5614 PRT 524105	127	Hart Scientific	01/17/05
35.000°C	7310 water bath	012	Polyscience	5614 PRT 524105	127	Hart Scientific	01/17/05

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J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 08-18-2004 RECOMMENDED* RECALIBRATION DATE: August 18, 2005

**NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available for download in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.*

**The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for liquid-in-glass thermometers (see section 8.3) and for portable electronic thermometers (PETs). See section 8.2*

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This Report of Test may not be reproduced except in full without the express written permission of ICL Calibration Laboratories, Inc.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

ACCREDITED CERT # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
Members: **ASTM NCSL ASQ NCWM**
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Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com

Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, (WHICH SUPERCEDED AND REPLACED MIL-STD 45662A), AND THE ISO-9000 AND QS-9000 SERIES OF QUALITY STANDARDS.

Domarre
EXHIBIT NO. 14
9-9-04
M. Green

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 06-02-2004

INSTRUMENT DESCRIPTION:

Serial No: 091795 Inscription: GUTH LABS INC. Date report issued: 06-07-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 ACCURACY TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: *ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563*

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.000°C	33.00°C	33.00°C	0.00°C	0.023°C
34.000°C	34.00°C	34.00°C	0.00°C	0.023°C
35.000°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: J. JEFF KELLY

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and comparator(s) utilized in the performance of this calibration are listed below:

Our NIST primary reference thermometer from -196 to 420C is a Hart Scientific model# 5699, 25.5 Ohm SPRT, serial no. 0159, calibrated by NIST on October 7, 2003. NIST GMP-11 recommends a 36 month calibration cycle for SPRTs. Transfer standards PRTs are calibrated against this reference standard semi-annually; ASTM liquid-in-glass transfer standards are calibrated annually. Our primary reference thermometer for temperatures from 420 to 1000C is a Hart Scientific Type 'S' thermocouple sensor, serial no. 9112, calibrated by Hart Scientific on January 13, 2003. This standard is on a 24 month calibration cycle.

Test Point	Comparator	MTE#	Manufacturer	Transfer Standard	MTE#	Manufacturer	Next Due
33.000°C	7310 water bath	006	PolyScience	5614 PRT 537360	129	Hart Scientific	07/16/04
34.000°C	7310 water bath	006	PolyScience	5614 PRT 537360	129	Hart Scientific	07/16/04
35.000°C	7310 water bath	006	PolyScience	5614 PRT 537360	129	Hart Scientific	07/16/04

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

This document prepared by LORI PARR and reviewed by MICHAEL KELLY

DATE REPORT ISSUED: 06-07-2004 RECOMMENDED* RECALIBRATION DATE: June 07, 2005

*NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available for download in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

*The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for liquid-in-glass thermometers (see section 8.3) and for portable electronic thermometers (PETs). See section 8.2

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

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CERT # 526.01

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THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 15
9-9-04
M. Green

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 06-20-2003

INSTRUMENT DESCRIPTION:

Serial No: 091795 Inscription: GUTH LABS INC. Date report issued: 06-27-2003 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

NOTE: The contacts for the on/off switch were cleaned prior to calibration.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.00°C	33.00°C	0.00°C	0.023°C
34.00°C	34.00°C	34.00°C	0.00°C	0.023°C
35.00°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH

ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-12
TEMP: 34.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-12
TEMP: 35.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-12

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN APRIL, 2002. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JANUARY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2002 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

Deborah M. Weber

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 06-27-2003   RECOMMENDED RECALIBRATION DATE: June 27, 2004

NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'.
Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals.
Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals.
NIST GMP-11 is available for viewing in .pdf format on our website at www.icllabs.com Follow the link for 'How often should I recalibrate...?

The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

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CERT # 526.01

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REPORT OF TEST FOR DIGITAL THERMOMETER

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Demarre
EXHIBIT NO. 16
9-9-04
M. Green

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 01-15-2004

INSTRUMENT DESCRIPTION:

Serial No: 091796 Inscription: GUTH LABS INC. Date report issued: 01-20-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

NOTE: Client's battery read 7.2 volts - replaced with new battery prior to calibration.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.00°C	33.00°C	0.00°C	0.023°C
34.00°C	34.00°C	34.00°C	0.00°C	0.023°C
35.00°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

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LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

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ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: J. JEFF KELLY

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THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 0159, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-12
TEMP: 34.00°C Reference: NIST SPRT S/N 0159, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-12
TEMP: 35.00°C Reference: NIST SPRT S/N 0159, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-12

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A HART SCIENTIFIC MODEL 5699 25.5 OHM SPRT, CALIBRATED BY NIST IN OCTOBER, 2003. NIST GMP-11 SPECIFIES A THREE YEAR CALIBRATION INTERVAL FOR SPRTs. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JANUARY OF 2004, AND ARE ON A SIX MONTH CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to 0.01C: +/- 0.00015C; 0.01C: +/- .00002C; >0 to 231.928C: +/- 0.00024C; >231.928C to 419.527C: +/- 0.00041C.

ICL CALIBRATION LABORATORIES, INC.

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J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 01-20-2004 RECOMMENDED RECALIBRATION DATE: January 20, 2005

NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

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ACCREDITED CERT # 526.01

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Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

CUSTOMER INFORMATION:

Demarre
EXHIBIT NO. 17
9-9-04
M. Green

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 06-06-2003

ISO/IEC 17025 and ANSI/NCSL Z540-1 — NIST TRACEABLE — ICL CALIBRATION LABORATORIES, INC.

INSTRUMENT DESCRIPTION:

Serial No: 091796 Inscription: GUTH LABS INC. Date report issued: 06-17-2003 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: *ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563*

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.00°C	33.00°C	0.00°C	0.023°C
34.00°C	34.00°C	34.00°C	0.00°C	0.023°C
35.00°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-12
TEMP: 34.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-12
TEMP: 35.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-12

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN APRIL, 2002. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JANUARY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2002 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

Deborah M. Weber

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 06-17-2003 RECOMMENDED RECALIBRATION DATE: June 17, 2004

NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available for viewing in .pdf format on our website at www.icllabs.com Follow the link for 'How often should I recalibrate...?

The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

SERIAL NUMBER: 091796 REPORT NUMBER: LF115818

NOTES:
The on/off touch pad was cleaned prior to calibration.

ICL CALIBRATION LABORATORIES, INC.

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
Members: **ASTM NCSL ASQ NCWM**
Setting new standards in calibration excellence!

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Tel: 772 286 7710 **1-800-713-6647**
Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com
Field office: Caguas, PR Tel: 787 286 7448

ACCREDITED CERT # 526.01

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 18
9-9-04
M. Green

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 02-16-2004

ACCREDITED TO ISO/IEC 17025 and ANSI/NCSL Z 540-1 NIST TRACEABLE ICL CALIBRATION LABORATORIES, INC.

INSTRUMENT DESCRIPTION:

Serial No: 091797 Inscription: GUTH LABS INC. Date report issued: 02-23-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.00°C	33.00°C	0.00°C	0.023°C
34.00°C	34.00°C	34.00°C	0.00°C	0.023°C
35.00°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and comparator(s) utilized in the performance of this calibration are listed below:

Our NIST primary reference thermometer from -196 to 420C is a Hart Scientific model# 5699, 25.5 Ohm SPRT, serial no. 0159, calibrated by NIST on October 7, 2003. NIST GMP-11 recommends a 36 month calibration cycle for SPRTs. Transfer standards PRTs are calibrated against this reference standard semi-annually; ASTM liquid-in-glass transfer standards are calibrated annually. Our primary reference thermometer for temperatures from 420 to 1000C is a Hart Scientific Type 'S' thermocouple sensor, serial no. 9112, calibrated by Hart Scientific on January 13, 2003. This standard is on a 24 month calibration cycle.

Test Point	Comparator	MTE#	Manufacturer	Transfer Standard	MTE#	Manufacturer	Next Due
33.00°C	7310 Water bath	012	Polyscience	5614 PRT	127	Hart Scientific	07/16/04
34.00°C	7310 Water bath	012	Polyscience	5614 PRT	127	Hart Scientific	07/16/04
35.00°C	7310 Water bath	012	Polyscience	5614 PRT	127	Hart Scientific	07/16/04

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 02-23-2004 RECOMMENDED* RECALIBRATION DATE: February 23, 2005

*NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available for download in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

*The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for liquid-in-glass thermometers (see section 8.3) and for portable electronic thermometers (PETs). See section 8.2

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

CERT # 528.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
Members: **ASTM NCSL ASQ NCWM**

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1501 Decker Avenue Suite 118 Stuart, FL 34994 USA
Tel: 772 286 7710 **1-800-713-6647**
Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com

Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 19
9-9-04
M. Green

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 03-28-2003

INSTRUMENT DESCRIPTION:

Serial No: 091797 Inscription: GUTH LABS INC. Date report issued: 04-02-2003 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

NIST TRACEABLE

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	32.97°C	33.00°C	0.00°C	0.023°C
34.00°C	33.97°C	34.00°C	0.00°C	0.023°C
35.00°C	34.97°C	35.00°C	0.00°C	0.023°C

THE 'AS FOUND' READINGS WERE NOT WITHIN THE TOLERANCE STATED ABOVE AND THIS INSTRUMENT WAS ADJUSTED ACCORDINGLY. THE NEW VALUES ARE SHOWN IN THE 'AS LEFT' COLUMN IN THE ABOVE TABLE.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODOLOGY ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 DOCUMENT ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-22
TEMP: 34.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 537360 & 24453 Comparator: PolyScience water bath MTE-06
TEMP: 35.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-22

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN APRIL, 2002. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JANUARY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2002 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

This document prepared by LORI PARR and reviewed by MICHAEL KELLY

DATE REPORT ISSUED: 04-02-2003 *RECOMMENDED RECALIBRATION DATE: April 02, 2004*
NBS GMP-11, 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values.' GMP-11, P4 recommends recalibration of liquid-in-glass thermometers and 100 ohm PRTs at 6 month intervals for 'Temperature Critical Parameters', or 12 month intervals for thermometers used for 'Secondary Parameters'.
The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

CERT # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
Members: **ASTM NCSL ASQ NCWM**
Setting new standards in calibration excellence!

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Tel: 772 286 7710 **1-800-713-6647**
Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com

Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 20
9-9-04
M. Green

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 02-16-2004

INSTRUMENT DESCRIPTION:

Serial No: 091797 Inscription: GUTH LABS INC. Date report issued: 02-23-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.00°C	33.00°C	0.00°C	0.023°C
34.00°C	34.00°C	34.00°C	0.00°C	0.023°C
35.00°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and comparator(s) utilized in the performance of this calibration are listed below:

Our NIST primary reference thermometer from -196 to 420C is a Hart Scientific model# 5699, 25.5 Ohm SPRT, serial no. 0159, calibrated by NIST on October 7, 2003. NIST GMP-11 recommends a 36 month calibration cycle for SPRTs. Transfer standards PRTs are calibrated against this reference standard semi-annually; ASTM liquid-in-glass transfer standards are calibrated annually. Our primary reference thermometer for temperatures from 420 to 1000C is a Hart Scientific Type 'S' thermocouple sensor, serial no. 9112, calibrated by Hart Scientific on January 13, 2003. This standard is on a 24 month calibration cycle.

Test Point	Comparator	MTE#	Manufacturer	Transfer Standard	MTE#	Manufacturer	Next Due
33.00°C	7310 Water bath	012	Polyscience	5614 PRT	127	Hart Scientific	07/16/04
34.00°C	7310 Water bath	012	Polyscience	5614 PRT	127	Hart Scientific	07/16/04
35.00°C	7310 Water bath	012	Polyscience	5614 PRT	127	Hart Scientific	07/16/04

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 02-23-2004 *RECOMMENDED* RECALIBRATION DATE: February 23, 2005*

**NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available for download in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.*

**The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for liquid-in-glass thermometers (see section 8.3) and for portable electronic thermometers (PETs). See section 8.2*

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This Report of Test may not be reproduced except in full without the express written permission of ICL Calibration Laboratories, Inc.

This report applies only to the item calibrated.

SERIAL NUMBER: 091797 *REPORT NUMBER: MB120378*

ICL CALIBRATION LABORATORIES, INC.

CERT # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
Members: **ASTM NCSL ASQ NCWM**

Setting new standards in calibration excellence!

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Tel: 772 286 7710 **1-800-713-6647**
Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com

Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 21
9-9-04
M. Green

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL *DATE RECEIVED FOR CALIBRATION: 01-21-2004*

INSTRUMENT DESCRIPTION:

Serial No: 091798 Inscription: GUTH LABS INC. Date report issued: 01-22-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

NOTE: Battery checked prior to calibration and is in satisfactory state of charge.

CALIBRATION PROCEDURE USED: *ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563*

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.00°C	33.00°C	0.00°C	0.023°C
34.00°C	34.00°C	34.00°C	0.00°C	0.023°C
35.00°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH

ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: J. JEFF KELLY

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 0159, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06
TEMP: 34.00°C Reference: NIST SPRT S/N 0159, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06
TEMP: 35.00°C Reference: NIST SPRT S/N 0159, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A HART SCIENTIFIC MODEL 5699 25.5 OHM SPRT, CALIBRATED BY NIST IN OCTOBER, 2003. NIST GMP-11 SPECIFIES A THREE YEAR CALIBRATION INTERVAL FOR SPRTs. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JANUARY OF 2004, AND ARE ON A SIX MONTH CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to 0.01C: +/- 0.00015C; 0.01C: +/- .00002C; >0 to 231.928C: +/- 0.00024C; >231.928C to 419.527C: +/- 0.00041C.

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. Jeff Kelly

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 01-22-2004 RECOMMENDED RECALIBRATION DATE: January 22, 2005

NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

CERT. # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
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Internet: www.icllabs.com

Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, (WHICH SUPERCEDED AND REPLACED MIL-STD 45662A), AND THE ISO-9000 AND QS-9000 SERIES OF QUALITY STANDARDS.

CUSTOMER INFORMATION:

Demarre
EXHIBIT NO. 22
9-9-04
M. Green

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 07-01-2004

Accredited to ISO/IEC 17025 and ANSI/NCSL Z-540-1 — NIST TRACEABLE — ICL CALIBRATION LABORATORIES, INC.

INSTRUMENT DESCRIPTION:

Serial No: 091798 Inscription: GUTH LABS INC. Date report issued: 07-07-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 ACCURACY TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.000°C	33.00°C	33.00°C	0.00°C	0.023°C
34.000°C	34.00°C	34.00°C	0.00°C	0.023°C
35.000°C	34.99°C	34.99°C	0.01°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND

ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

This calibration is traceable to NIST through a direct chain of comparisons.

The NIST primary reference standard(s), transfer standard(s) and comparator(s) utilized in the performance of this calibration are listed below:

Our NIST primary reference thermometer from -196 to 420C is a Hart Scientific model# 5699, 25.5 Ohm SPRT, serial no. 0159, calibrated by NIST on October 7, 2003. NIST GMP-11 recommends a 36 month calibration cycle for SPRTs. Transfer standards PRTs are calibrated against this reference standard semi-annually; ASTM liquid-in-glass transfer standards are calibrated annually. Our primary reference thermometer for temperatures from 420 to 1000C is a Hart Scientific Type 'S' thermocouple sensor, serial no. 9112, calibrated by Hart Scientific on January 13, 2003. This standard is on a 24 month calibration cycle.

Test Point	Comparator	MTE#	Manufacturer	Transfer Standard	MTE#	Manufacturer	Next Due
33.000°C	7310 water bath	006	PolyScience	5614 PRT 576776	130	Hart Scientific	07/16/04
34.000°C	7310 water bath	006	PolyScience	5614 PRT 576776	130	Hart Scientific	07/16/04
35.000°C	7310 water bath	006	PolyScience	5614 PRT 576776	130	Hart Scientific	07/16/04

ICL CALIBRATION LABORATORIES, INC.

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J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 07-07-2004 RECOMMENDED* RECALIBRATION DATE: July 07, 2005

*NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available for download in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

*The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for liquid-in-glass thermometers (see section 8.3) and for portable electronic thermometers (PETs). See section 8.2

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

CERT # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
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Members: **ASTM NCSL ASQ NCWM**

Setting new standards in calibration excellence!

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Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com

Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, (WHICH SUPERCEDED AND REPLACED MIL-STD 45662A), AND THE ISO-9000 AND QS-9000 SERIES OF QUALITY STANDARDS.

CUSTOMER INFORMATION:

Demarre
EXHIBIT NO. 23
9-9-04
M. Green

ACCREDITED TO ISO/IEC 17025 AND ANSI/NCSL Z 540-1
NIST TRACEABLE
ICL CALIBRATION LABORATORIES, INC.

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 03-26-2004

INSTRUMENT DESCRIPTION:

Serial No: 091799 Inscription: GUTH LABS INC. Date report issued: 03-31-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 ACCURACY TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: *ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563*

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.00°C	33.00°C	0.00°C	0.023°C
34.00°C	34.00°C	34.00°C	0.00°C	0.023°C
35.00°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and comparator(s) utilized in the performance of this calibration are listed below:

Our NIST primary reference thermometer from -196 to 420C is a Hart Scientific model# 5699, 25.5 Ohm SPRT, serial no. 0159, calibrated by NIST on October 7, 2003. NIST GMP-11 recommends a 36 month calibration cycle for SPRTs. Transfer standards PRTs are calibrated against this reference standard semi-annually; ASTM liquid-in-glass transfer standards are calibrated annually. Our primary reference thermometer for temperatures from 420 to 1000C is a Hart Scientific Type 'S' thermocouple sensor, serial no. 9112, calibrated by Hart Scientific on January 13, 2003. This standard is on a 24 month calibration cycle.

Test Point	Comparator	MTE#	Manufacturer	Transfer Standard	MTE#	Manufacturer	Next Due
33.00°C	7310 Water bath	012	Polyscience	5614 PRT	129	Hart Scientific	07/16/04
34.00°C	7310 Water bath	012	Polyscience	5614 PRT	129	Hart Scientific	07/16/04
35.00°C	7310 Water bath	012	Polyscience	5614 PRT	129	Hart Scientific	07/16/04

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. Jeff Kelly

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

Karen Alleborn

DATE REPORT ISSUED: 03-31-2004 RECOMMENDED* RECALIBRATION DATE: March 31, 2005

*NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available for download in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

*The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for liquid-in-glass thermometers (see section 8.3) and for portable electronic thermometers (PETs). See section 8.2

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

CERT # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
Members: **ASTM NCSL ASQ NCWM**
Setting new standards in calibration excellence!

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Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com
Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 24
9-9-04
M. Green

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 03-28-2003

INSTRUMENT DESCRIPTION:

Serial No: 091799 Inscription: GUTH LABS INC. Date report issued: 04-02-2003 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.04°C	33.00°C	0.00°C	0.023°C
34.00°C	34.04°C	34.00°C	0.00°C	0.023°C
35.00°C	35.04°C	35.00°C	0.00°C	0.023°C

THE 'AS FOUND' READINGS WERE NOT WITHIN THE TOLERANCE STATED ABOVE AND THIS INSTRUMENT WAS ADJUSTED ACCORDINGLY. THE NEW VALUES ARE SHOWN IN THE 'AS LEFT' COLUMN IN THE ABOVE TABLE.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODOLOGY ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 DOCUMENT ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-22
TEMP: 34.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 537360 & 24453 Comparator: PolyScience water bath MTE-06
TEMP: 35.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-22

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN APRIL, 2002. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JANUARY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2002 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

This document prepared by LORI PARR and reviewed by MICHAEL KELLY

DATE REPORT ISSUED: 04-02-2003 RECOMMENDED RECALIBRATION DATE: April 02, 2004

NBS GMP-11, 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values.' GMP-11, P4 recommends recalibration of liquid-in-glass thermometers and 100 ohm PRTs at 6 month intervals for 'Temperature Critical Parameters', or 12 month intervals for thermometers used for 'Secondary Parameters'.
The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

SERIAL NUMBER: 091799
REPORT NUMBER: LC114520

ICL CALIBRATION LABORATORIES, INC.

ACCREDITED CERT # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
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Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com

Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 25
9-9-04
M. Green

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 01-21-2004

INSTRUMENT DESCRIPTION:

Serial No: 091800 Inscription: GUTH LABS INC. Date report issued: 01-22-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

NOTE: Battery checked prior to calibration and is in satisfactory state of charge.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.01°C	33.01°C	-0.01°C	0.023°C
34.00°C	34.01°C	34.01°C	-0.01°C	0.023°C
35.00°C	35.01°C	35.01°C	-0.01°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH

ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: J. JEFF KELLY

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 0159, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06
TEMP: 34.00°C Reference: NIST SPRT S/N 0159, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06
TEMP: 35.00°C Reference: NIST SPRT S/N 0159, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A HART SCIENTIFIC MODEL 5699 25.5 OHM SPRT, CALIBRATED BY NIST IN OCTOBER, 2003. NIST GMP-11 SPECIFIES A THREE YEAR CALIBRATION INTERVAL FOR SPRTs. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JANUARY OF 2004, AND ARE ON A SIX MONTH CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to 0.01C: +/- 0.00015C; 0.01C: +/- .00002C; >0 to 231.928C: +/- 0.00024C; >231.928C to 419.527C: +/- 0.00041C.

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. Jeff Kelly

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 01-22-2004 RECOMMENDED RECALIBRATION DATE: January 22, 2005

NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

CERT. # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
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Members: **ASTM NCSL ASQ NCWM**

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Tel: 772 286 7710 **1-800-713-6647**
Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com

Field office: Caguas, PR Tel: 787 286 7446

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 26
9-9-04
M. Green

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 03-05-2003

INSTRUMENT DESCRIPTION:

Serial No: 091800 Inscription: GUTH LABS INC. Date report issued: 03-11-2003 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.00°C	33.00°C	0.00°C	0.023°C
34.00°C	34.00°C	34.00°C	0.00°C	0.023°C
35.00°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODOLOGY ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 DOCUMENT ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: J. JEFF KELLY

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06
TEMP: 34.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06
TEMP: 35.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN APRIL, 2002. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JANUARY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2002 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to < 0C: +/- 0.0023C; 0.01C: +/- .0014C; > 0 to 95C: +/- 0.0024C; > 95C to 300C: +/- 0.0048C; > 300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 03-11-2003 RECOMMENDED RECALIBRATION DATE: March 11, 2004
NBS GMP-11, 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values.' GMP-11, P4 recommends recalibration of liquid-in-glass thermometers and 100 ohm PRTs at 6 month intervals for 'Temperature Critical Parameters', or 12 month intervals for thermometers used for 'Secondary Parameters'.
The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

SERIAL NUMBER: 091800
REPORT NUMBER: LC114160

ICL CALIBRATION LABORATORIES, INC.

CERT # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
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Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com

Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 27
9-9-04
M. Green

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL   DATE RECEIVED FOR CALIBRATION: 09-05-2003

INSTRUMENT DESCRIPTION:

Serial No: 091800   Inscription: GUTH LABS INC.   Date report issued: 09-08-2003   Scale: Celsius (Centigrade)

DIGITAL THERMOMETER   Scale range: 29.5/38.5C   Scale divisions: .01 °C   Immersion: PROBE

MODEL NO: 4300   TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

ISO/IEC 17025 and ANSI/NCSL Z 540-1 NIST TRACEABLE ICL CALIBRATION LABORATORIES, INC.

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

NOTE: The on/off touch pad connection was cleaned prior to calibration.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.00°C	33.00°C	0.00°C	0.023°C
34.00°C	34.00°C	34.00°C	0.00°C	0.023°C
35.00°C	35.01°C	35.01°C	-0.01°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH

ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-12
TEMP: 34.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-12
TEMP: 35.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-12

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN JULY, 2003. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JULY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2003 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

Deborah M. Weber

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 09-08-2003   RECOMMENDED RECALIBRATION DATE: September 08, 2004

NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'.
Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals.
Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals.
NIST GMP-11 is available in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

ACCREDITED CERT # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
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Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com
Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 28
9-9-04
M. Green

ISO/IEC 17025 and ANSI/NCSL Z 540-1 ... NIST TRACEABLE ... ICL CALIBRATION LABORATORIES, INC.

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 03-05-2003

INSTRUMENT DESCRIPTION:

Serial No: 091801 Inscription: GUTH LABS INC. Date report issued: 03-11-2003 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: *ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563*

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.00°C	33.00°C	0.00°C	0.023°C
34.00°C	34.00°C	34.00°C	0.00°C	0.023°C
35.00°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODOLOGY ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 DOCUMENT ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: J. JEFF KELLY

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06
TEMP: 34.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06
TEMP: 35.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN APRIL, 2002. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JANUARY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2002 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 03-11-2003 RECOMMENDED RECALIBRATION DATE: March 11, 2004
NBS GMP-11, 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values.' GMP-11, P4 recommends recalibration of liquid-in-glass thermometers and 100 ohm PRTs at 6 month intervals for 'Temperature Critical Parameters', or 12 month intervals for thermometers used for 'Secondary Parameters'.
The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

SERIAL NUMBER: 091801
REPORT NUMBER: LC114159

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Tel: 772 286 7710 **1-800-713-6647**
Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com
Field office: Caguas, PR Tel: 787 286 7448

ACCREDITED CERT # 526.01

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

CUSTOMER INFORMATION:

Demarre
EXHIBIT NO. 29
9-9-04
M. Green

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 03-11-2004

INSTRUMENT DESCRIPTION:

Serial No: 091801 Inscription: GUTH LABS INC. Date report issued: 03-15-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

ISO/IEC 17025 and ANSI/NCSL Z 540-1 NIST TRACEABLE ICL CALIBRATION LABORATORIES, INC.

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.01°C	33.01°C	-0.01°C	0.023°C
34.00°C	34.01°C	34.01°C	-0.01°C	0.023°C
35.00°C	35.01°C	35.01°C	-0.01°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and comparator(s) utilized in the performance of this calibration are listed below:

Our NIST primary reference thermometer from -196 to 420C is a Hart Scientific model# 5699, 25.5 Ohm SPRT, serial no. 0159, calibrated by NIST on October 7, 2003. NIST GMP-11 recommends a 36 month calibration cycle for SPRTs. Transfer standards PRTs are calibrated against this reference standard semi-annually; ASTM liquid-in-glass transfer standards are calibrated annually. Our primary reference thermometer for temperatures from 420 to 1000C is a Hart Scientific Type 'S' thermocouple sensor, serial no. 9112, calibrated by Hart Scientific on January 13, 2003. This standard is on a 24 month calibration cycle.

Test Point	Comparator	MTE#	Manufacturer	Transfer Standard	MTE#	Manufacturer	Next Due
33.00°C	7310 Water bath	012	Polyscience	5614 PRT	127	Hart Scientific	07/16/04
34.00°C	7310 Water bath	012	Polyscience	5614 PRT	127	Hart Scientific	07/16/04
35.00°C	7310 Water bath	012	Polyscience	5614 PRT	127	Hart Scientific	07/16/04

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 03-15-2004 RECOMMENDED* RECALIBRATION DATE: March 15, 2005

*NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available for download in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

*The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for liquid-in-glass thermometers (see section 8.3) and for portable electronic thermometers (PETs). See section 8.2

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

ACCREDITED
CERT # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
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1501 Decker Avenue Suite 118 Stuart, FL 34994 USA
Tel: 772 286 7710 **1-800-713-6647**
Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com

Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Damarre
EXHIBIT NO. 30
9-9-04
M. Green

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 09-05-2003

ISO/IEC 17025 and ANSI/NCSL Z540-1 NIST TRACEABLE CALIBRATION LABORATORIES, INC.

INSTRUMENT DESCRIPTION:

Serial No: 091801 Inscription: GUTH LABS INC. Date report issued: 09-08-2003 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

NOTE: The on/off touch pad connection was cleaned prior to calibration.

CALIBRATION PROCEDURE USED: *ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563*

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.00°C	33.00°C	0.00°C	0.023°C
34.00°C	34.00°C	34.00°C	0.00°C	0.023°C
35.00°C	35.01°C	35.01°C	-0.01°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH

ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-12
TEMP: 34.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-12
TEMP: 35.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-12

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN JULY, 2003. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JULY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2003 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

Deborah M. Weber

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 09-08-2003 RECOMMENDED RECALIBRATION DATE: September 08, 2004

NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

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REPORT OF TEST FOR DIGITAL THERMOMETER

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Demarre
EXHIBIT NO. 31
9-9-04
M. Green

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 06-10-2004

ISO/IEC 17025 and ANSI/NCSL ... NIST TRACEABLE ... ICL CALIBRATION LABORATORIES

INSTRUMENT DESCRIPTION:

Serial No: 091802 Inscription: GUTH LABS INC. Date report issued: 06-14-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 ACCURACY TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.000°C	33.01°C	33.01°C	-0.01°C	0.023°C
34.000°C	34.01°C	34.01°C	-0.01°C	0.023°C
35.000°C	35.01°C	35.01°C	-0.01°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

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THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and comparator(s) utilized in the performance of this calibration are listed below:

Our NIST primary reference thermometer from -196 to 420C is a Hart Scientific model# 5699, 25.5 Ohm SPRT, serial no. 0159, calibrated by NIST on October 7, 2003. NIST GMP-11 recommends a 36 month calibration cycle for SPRTs. Transfer standards PRTs are calibrated against this reference standard semi-annually; ASTM liquid-in-glass transfer standards are calibrated annually. Our primary reference thermometer for temperatures from 420 to 1000C is a Hart Scientific Type 'S' thermocouple sensor, serial no. 9112, calibrated by Hart Scientific on January 13, 2003. This standard is on a 24 month calibration cycle.

Test Point	Comparator	MTE#	Manufacturer	Transfer Standard	MTE#	Manufacturer	Next Due
33.000°C	7310 water bath	006	PolyScience	5614 PRT 576776	130	Hart Scientific	07/16/04
34.000°C	7310 water bath	006	PolyScience	5614 PRT 576776	130	Hart Scientific	07/16/04
35.000°C	7310 water bath	006	PolyScience	5614 PRT 576776	130	Hart Scientific	07/16/04

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 06-14-2004 RECOMMENDED* RECALIBRATION DATE: June 14, 2005

**NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available for download in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.*

**The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for liquid-in-glass thermometers (see section 8.3) and for portable electronic thermometers (PETs). See section 8.2*

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

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Demarre
EXHIBIT NO. 32
9-9-04
M. Green

Accredited to ISO/IEC 17025 and ANSI/NCSL Z 540-1 NIST TRACEABLE ICL CALIBRATION LABORATORIES, INC.

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 06-25-2003

INSTRUMENT DESCRIPTION:

Serial No: 091802 Inscription: GUTH LABS INC. Date report issued: 07-02-2003 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

NOTE: The on/off switch pad contacts were cleaned prior to calibration.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.01°C	33.01°C	-0.01°C	0.023°C
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ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

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TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 537360 & 24453 Comparator: PolyScience water bath MTE-06
TEMP: 34.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 537360 & 24453 Comparator: PolyScience water bath MTE-06
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J. Jeff Kelly

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 07-02-2003 RECOMMENDED RECALIBRATION DATE: July 02, 2004

NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'.
Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals.
Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals.
NIST GMP-11 is available for viewing in .pdf format on our website at www.icllabs.com Follow the link for 'How often should I recalibrate...?

The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

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Members: **ASTM NCSL ASQ NCWM**
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ACCREDITED CERT # 526.01

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Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

CUSTOMER INFORMATION:

Demarre
EXHIBIT NO. 33
9-9-04
M. Green

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 12-16-2003

INSTRUMENT DESCRIPTION:

Serial No: 091802 Inscription: GUTH LABS INC. Date report issued: 12-18-2003 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.01°C	33.01°C	-0.01°C	0.023°C
34.00°C	34.01°C	34.01°C	-0.01°C	0.023°C
35.00°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06
TEMP: 34.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06
TEMP: 35.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 537360 & 576776 Comparator: PolyScience water bath MTE-06

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN JULY, 2003. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JULY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2003 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

Deborah M. Weber

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 12-18-2003 RECOMMENDED RECALIBRATION DATE: December 18, 2004

NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

CERT # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
Members: **ASTM NCSL ASQ NCWM**

Setting new standards in calibration excellence!

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Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com

Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

CUSTOMER INFORMATION:

Demarre
EXHIBIT NO. 34
9-9-04
M. Green

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 04-25-2003

INSTRUMENT DESCRIPTION:

Serial No: 091803 Inscription: GUTH LABS INC. Date report issued: 05-01-2003 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

NOTE: The touch pad for the on/off switch was cleaned prior to calibration.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.01°C	33.01°C	-0.01°C	0.023°C
34.00°C	34.01°C	34.01°C	-0.01°C	0.023°C
35.00°C	35.01°C	35.01°C	-0.01°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODOLOGY ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 DOCUMENT ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH

ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-06
TEMP: 34.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-06
TEMP: 35.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-06

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN APRIL, 2002. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JANUARY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2002 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

Deborah M. Weber

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 05-01-2003 RECOMMENDED RECALIBRATION DATE: May 01, 2004
NBS GMP-11, 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values.' GMP-11, P4 recommends recalibration of liquid-in-glass thermometers and 100 ohm PRTs at 6 month intervals for 'Temperature Critical Parameters', or 12 month intervals for thermometers used for 'Secondary Parameters'.
The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

CERT # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
Members: **ASTM NCSL ASQ NCWM**
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Internet: www.icllabs.com
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REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, (WHICH SUPERCEDED AND REPLACED MIL-STD 45662A), AND THE ISO-9000 AND QS-9000 SERIES OF QUALITY STANDARDS.

CUSTOMER INFORMATION:

Demarre
EXHIBIT NO. 35
9-9-04
M. Green

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 05-10-2004

ISO/IEC 17025 and ANSI/NCSL Z 540-1 NIST TRACEABLE ICL CALIBRATION LABORATORIES, INC.

INSTRUMENT DESCRIPTION:

Serial No: 091803 Inscription: GUTH LABS INC. Date report issued: 05-10-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 ACCURACY TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.00°C	33.00°C	0.00°C	0.023°C
34.00°C	34.00°C	34.00°C	0.00°C	0.023°C
35.00°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: J. JEFF KELLY

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and comparator(s) utilized in the performance of this calibration are listed below:

Our NIST primary reference thermometer from -196 to 420C is a Hart Scientific model# 5699, 25.5 Ohm SPRT, serial no. 0159, calibrated by NIST on October 7, 2003. NIST GMP-11 recommends a 36 month calibration cycle for SPRTs. Transfer standards PRTs are calibrated against this reference standard semi-annually; ASTM liquid-in-glass transfer standards are calibrated annually. Our primary reference thermometer for temperatures from 420 to 1000C is a Hart Scientific Type 'S' thermocouple sensor, serial no. 9112, calibrated by Hart Scientific on January 13, 2003. This standard is on a 24 month calibration cycle.

Test Point	Comparator	MTE#	Manufacturer	Transfer Standard	MTE#	Manufacturer	Next Due
33.00°C	7310 water bath	006	PolyScience	5614 PRT 576776	130	Hart Scientific	07/16/04
34.00°C	7310 water bath	006	PolyScience	5614 PRT 576776	130	Hart Scientific	07/16/04
35.00°C	7310 water bath	006	PolyScience	5614 PRT 576776	130	Hart Scientific	07/16/04

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn
This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 05-10-2004 RECOMMENDED* RECALIBRATION DATE: May 10, 2005

*NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available for download in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

*The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for liquid-in-glass thermometers (see section 8.3) and for portable electronic thermometers (PETs). See section 8.2

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

ACCREDITED CERT # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
Members: **ASTM NCSL ASQ NCWM**

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Internet: www.icllabs.com

Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 36
9-9-04
M. Green

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL   DATE RECEIVED FOR CALIBRATION: 11-05-2003

ISO/IEC 17025 and ANSI/NCSL Z540-1 NIST TRACEABLE CALIBRATION LABORATORIES INC

INSTRUMENT DESCRIPTION:

Serial No: 091803   Inscription: GUTH LABS INC.   Date report issued: 11-07-2003   Scale: Celsius (Centigrade)

DIGITAL THERMOMETER   Scale range: 29.5/38.5C   Scale divisions: .01 °C   Immersion: PROBE

MODEL NO: 4300   TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: *ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563*

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.00°C	33.00°C	0.00°C	0.023°C
34.00°C	34.00°C	34.00°C	0.00°C	0.023°C
35.00°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: J. JEFF KELLY

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 524105 & 24453 Comparator: PolyScience water bath MTE-12
TEMP: 34.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 524105 & 24453 Comparator: PolyScience water bath MTE-12
TEMP: 35.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 524105 & 24453 Comparator: PolyScience water bath MTE-12

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN JULY, 2003. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JULY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2003 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 11-07-2003 RECOMMENDED RECALIBRATION DATE: November 07, 2004

NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'.
Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals.
Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals.
NIST GMP-11 is available in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
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Members: ASTM NCSL ASQ NCWM
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Field sales office: Caguas, PR Tel: 787 286 7448

CERT. # 526.01

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 37
9-9-04
M. Green

CUSTOMER INFORMATION:

GUTH LABORATORIES, INC.
590 NORTH 67TH STREET
HARRISBURG, PA 17111

PURCHASE ORDER NUMBER: 2025706

SUBMITTED BY: GUTH LABORATORIES, INC. DATE RECEIVED FOR CALIBRATION: 06-26-2002

INSTRUMENT DESCRIPTION:

Serial No: 300905 Inscription: EUTECHNICS Date report issued: 07-10-2002 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: -20/130C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4400 TOLERANCE: +/- 0.015C

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: *ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563.*

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	32.99°C	32.99°C	0.01°C	0.021°C
34.00°C	33.99°C	33.99°C	0.01°C	0.021°C
35.00°C	34.99°C	34.99°C	0.01°C	0.021°C

THE 'AS FOUND' READINGS WERE WITHIN THE TOLERANCE STATED ABOVE AND NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM UNCERTAINTIES ARE AS FOLLOWS: FROM -80 to <-41C, +/- 0.045C; FROM -41 to <0C, +/- 0.017C; AT 0C, +/- 0.006C; FROM >0 to 28C, +/- 0.019C; FROM >28 to 105C, +/- 0.018C; FROM >105 to 150C, +/- 0.021C; FROM >150 to 200C, +/- 0.024C; FROM >200 TO 300C, +/- 0.039C; FROM 300 TO 410C, +/-0.052C; FROM >410 to 700C, +/-0.74C; FROM >700 to 900C, +/- 0.81C; >900C to 1000C, +/- 0.95C THESE UNCERTAINTIES HAVE BEEN CALCULATED ACCORDING TO ANSI-NCSL Z540-2, 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', USING A COVERAGE FACTOR OF K=2 TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: J. JEFF KELLY

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 537360 & 24453 Comparator: PolyScience water bath MTE-06
TEMP: 34.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 537360 & 24453 Comparator: PolyScience water bath MTE-06
TEMP: 35.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 537360 & 24453 Comparator: PolyScience water bath MTE-06

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN APRIL, 2001. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JANUARY OF 2002, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2001 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 07-10-2002 THIS CALIBRATION IS VALID THROUGH: July 10, 2003
The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

SERIAL NUMBER: 300905

REPORT NUMBER: KF109167

ICL CALIBRATION LABORATORIES, INC.

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
Members: ASTM NCSL ASQ NCWM

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Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com

Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 38
9-9-04
M. Green

CUSTOMER INFORMATION:

GUTH LABORATORIES, INC.
590 NORTH 67TH STREET
HARRISBURG, PA 17111

PURCHASE ORDER NUMBER: 2026181

SUBMITTED BY: GUTH LABORATORIES, INC. DATE RECEIVED FOR CALIBRATION: 07-08-2003

INSTRUMENT DESCRIPTION:

Serial No: 300905 Inscription: EUTECHNICS Date report issued: 07-14-2003 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: -20/130C Scale divisions: .01 °C. Immersion: PROBE

MODEL NO: 4400 TOLERANCE: +/- 0.015C

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.00°C	33.00°C	0.00°C	0.023°C
34.00°C	34.00°C	34.00°C	0.00°C	0.023°C
35.00°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.066C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: J. JEFF KELLY

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 537360 Comparator: PolyScience water bath MTE-06
TEMP: 34.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 537360 Comparator: PolyScience water bath MTE-06
TEMP: 35.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 537360 Comparator: PolyScience water bath MTE-06

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN APRIL, 2002. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JANUARY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2002 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

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J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 07-14-2003 RECOMMENDED RECALIBRATION DATE: July 14, 2004

NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'.
Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals.
Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals.
NIST GMP-11 is available for viewing in .pdf format on our website at www.icllabs.com Follow the link for 'How often should I recalibrate...?

The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

ACCREDITED CERT # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
Members: **ASTM NCSL ASQ NCWM**
Setting new standards in calibration excellence!

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Tel: 772 286 7710 **1-800-713-6647**
Fax: 772 286 8737 E-mail: jeff@icllabs.com
Internet: www.icllabs.com
Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 39
9-9-04
M. Green

Accredited to ISO/IEC 17025 and ANSI/NCSL Z 540-1 · NIST TRACEABLE · ICL CALIBRATION LABORATORIES, INC.

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 01-07-2004

INSTRUMENT DESCRIPTION:

Serial No: 302173 Inscription: GUTH LABS INC. Date report issued: 01-08-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.01°C	33.01°C	-0.01°C	0.023°C
34.00°C	34.01°C	34.01°C	-0.01°C	0.023°C
35.00°C	35.01°C	35.01°C	-0.01°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 524105 & 24453 Comparator: PolyScience water bath MTE-12
TEMP: 34.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 524105 & 24453 Comparator: PolyScience water bath MTE-12
TEMP: 35.00°C Reference: NIST SPRT S/N 1035, Transfer standards: 524105 & 24453 Comparator: PolyScience water bath MTE-12

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN JULY, 2003. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JULY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2003 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

Deborah M. Weber

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 01-08-2004 RECOMMENDED RECALIBRATION DATE: January 08, 2005

NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

ACCREDITED CERT. # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
Members: **ASTM NCSL ASQ NCWM**
Setting new standards in calibration excellence!

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Internet: www.icllabs.com
Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

Report No. MF123042 Page 1 of 2

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, (WHICH SUPERCEDED AND REPLACED MIL-STD 45662A), AND THE ISO-9000 AND QS-9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 40
9-9-04
M. Green

Accredited to ISO/IEC 17025 and ANSI/NCSL Z540-1 — NIST TRACEABLE — ICL CALIBRATION LABORATORIES, INC.

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 06-17-2004

INSTRUMENT DESCRIPTION:

Serial No: 302173 Inscription: GUTH LABS INC. Date report issued: 06-23-2004 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 ACCURACY TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

CALIBRATION PROCEDURE USED: *ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563*

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.000°C	33.00°C	33.00°C	0.00°C	0.023°C
34.000°C	34.00°C	34.00°C	0.00°C	0.023°C
35.000°C	35.00°C	35.00°C	0.00°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

This calibration is traceable to NIST through a direct chain of comparisons.

The NIST primary reference standard(s), transfer standard(s) and comparator(s) utilized in the performance of this calibration are listed below:

Our NIST primary reference thermometer from -196 to 420C is a Hart Scientific model# 5699, 25.5 Ohm SPRT, serial no. 0159, calibrated by NIST on October 7, 2003. NIST GMP-11 recommends a 36 month calibration cycle for SPRTs. Transfer standards PRTs are calibrated against this reference standard semi-annually; ASTM liquid-in-glass transfer standards are calibrated annually. Our primary reference thermometer for temperatures from 420 to 1000C is a Hart Scientific Type 'S' thermocouple sensor, serial no. 9112, calibrated by Hart Scientific on January 13, 2003. This standard is on a 24 month calibration cycle.

Test Point	Comparator	MTE#	Manufacturer	Transfer Standard	MTE#	Manufacturer	Next Due
33.000°C	7310 water bath	012	Polyscience	5614 PRT 537360	129	Hart Scientific	07/16/04
34.000°C	7310 water bath	012	Polyscience	5614 PRT 537360	129	Hart Scientific	07/16/04
35.000°C	7310 water bath	012	Polyscience	5614 PRT 537360	129	Hart Scientific	07/16/04

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 06-23-2004 RECOMMENDED* RECALIBRATION DATE: June 23, 2005

*NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available for download in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

*The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for liquid-in-glass thermometers (see section 8.3) and for portable electronic thermometers (PETs). See section 8.2

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

ICL CALIBRATION LABORATORIES, INC.

ACCREDITED CERT # 526.01

ISO/IEC 17025 and ANSI/NCSL Z540-1 accredited
The specialists in ASTM and laboratory thermometers & hydrometers
Members: **ASTM NCSL ASQ NCWM**

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Internet: www.icllabs.com

Field office: Caguas, PR Tel: 787 286 7448

REPORT OF TEST FOR DIGITAL THERMOMETER

THIS IS TO CERTIFY THAT THE INSTRUMENT DESCRIBED BELOW HAS BEEN EXAMINED AND TESTED IN ICL'S CALIBRATION LABORATORY USING THE MOST SENSITIVE MICROPROCESSOR CONTROLLED CONSTANT TEMPERATURE EQUIPMENT AVAILABLE, AGAINST NIST CALIBRATED PRIMARY REFERENCE STANDARDS, IN ACCORDANCE WITH ICL'S ISO/IEC 17025 CALIBRATION PROCEDURE REFERENCED BELOW. THIS CALIBRATION MEETS THE REQUIREMENTS OF ISO/IEC 17025, ANSI/NCSL Z540-1-1994, MIL-STD 45662A, THE ISO9000, AND THE QS9000 SERIES OF QUALITY STANDARDS.

Demarre
EXHIBIT NO. 47
9-9-04
M. Green

Accredited to ISO/IEC 17025 and ANSI/NCSL Z 540-1 — NIST TRACEABLE — ICL CALIBRATION LABORATORIES, INC

CUSTOMER INFORMATION:

WASHINGTON STATE PATROL
811 EAST ROANOKE
SEATTLE, WA 98102

PURCHASE ORDER NUMBER:

SUBMITTED BY: WASHINGTON STATE PATROL DATE RECEIVED FOR CALIBRATION: 07-21-2003

INSTRUMENT DESCRIPTION:

Serial No: 302173 Inscription: GUTH LABS INC. Date report issued: 07-28-2003 Scale: Celsius (Centigrade)

DIGITAL THERMOMETER Scale range: 29.5/38.5C Scale divisions: .01 °C Immersion: PROBE

MODEL NO: 4300 TOLERANCE: +/- 0.025C PER MANUFACTURER'S MANUAL

RESULTS OF PHYSICAL EXAMINATION:

THE PHYSICAL CONDITION OF THIS INSTRUMENT WAS SATISFACTORY AND IT APPEARED THAT ALL SYSTEMS WERE FUNCTIONAL.

NOTE: UUT was received with a low battery, a new 9 volt battery was inserted prior to calibration.

CALIBRATION PROCEDURE USED: *ICL Procedure 04, which is drawn from ASTM E-77, E-220 and E-563*

RESULTS OF CALIBRATION:

TEST TEMPERATURE	'AS FOUND' READING	'AS LEFT' READING	CORRECTION	EXPANDED UNCERTAINTY (K=2)
33.00°C	33.01°C	33.01°C	-0.01°C	0.023°C
34.00°C	34.01°C	34.01°C	-0.01°C	0.023°C
35.00°C	35.01°C	35.01°C	-0.01°C	0.023°C

NO ADJUSTMENTS WERE MADE TO THIS INSTRUMENT.

OUR CALIBRATION SYSTEM BEST MEASUREMENT UNCERTAINTIES ARE AS FOLLOWS: from -80 to 0C, +/- 0.019C; at 0C, +/- 0.006C; at 0.01C (TPW), +/-0.003C; from 0.01 to 105C, +/-0.020C; from 105 to 200C, +/- 0.030C; from 200 to 300C, +/- 0.049C; from 300 to 410C, +/-0.056C; from 410 to 1000C, +/- 1.2C. THESE UNCERTAINTIES HAVE BEEN CALCULATED UTILIZING THE METHODS ELABORATED IN NIST TECHNICAL NOTE 1297 AND THE ANSI-NCSL DOCUMENT Z-540-2 ENTITLED 'GUIDE TO THE EXPRESSION OF UNCERTAINTY IN MEASUREMENT', COMMONLY REFERRED TO AS THE 'GUM'. A COVERAGE FACTOR OF 2 SIGMA (K=2) HAS BEEN APPLIED TO THE STANDARD UNCERTAINTY IN ORDER TO EXPRESS THE EXPANDED UNCERTAINTY AT APPROXIMATELY A 95% CONFIDENCE LEVEL.

THE UNCERTAINTIES PRESENTED ABOVE IN THE 'RESULTS' TABLE MAY BE LARGER THAN OUR SYSTEM UNCERTAINTIES, AS THE RESOLUTION OF THIS INSTRUMENT, ESTIMATED TO BE 0.01°C, HAS BEEN FACTORED INTO THE CALCULATION.

THE EXPANDED UNCERTAINTIES (K=2) REPORTED HERE DO NOT CONTAIN ESTIMATES FOR (1) ANY EFFECTS THAT MAY BE INTRODUCED BY TRANSPORTATION OF THE INSTRUMENT BETWEEN ICL AND THE USER'S LABORATORY, (2) DRIFT OF THE INSTRUMENT, (3) HYSTERESIS OF THE INSTRUMENT, OR (4) ANY MEASUREMENT UNCERTAINTIES INTRODUCED BY THE USER.

LABORATORY ENVIRONMENTAL CONDITIONS: TEMPERATURE: 23°C +/- 2°C RELATIVE HUMIDITY: BETWEEN 40% AND 60%

ALL TEMPERATURES GIVEN IN THIS REPORT ARE THOSE DEFINED BY THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90)

IMPORTANT NOTE: THE CORRECT OPERATION OF DIGITAL ELECTRONIC THERMOMETERS IS DEPENDENT ON ALL COMPONENTS FUNCTIONING PROPERLY. CORRECT TEMPERATURE INDICATION MAY BE IMPEDED BY PHYSICAL DAMAGE TO THE PROBE OR CABLE ASSEMBLY, CONTAMINATION OF ELECTRICAL CONTACTS WITH WATER, OIL, OR OTHER MATERIAL, OR BY LESS OBVIOUS CAUSES SUCH AS LOW BATTERY LEVEL OR FAILURE OF INTERNAL COMPONENTS. ACCORDINGLY, ICL CALIBRATION LABORATORIES, INC. REPRESENTS THAT THE VALUES INDICATED ABOVE WERE THOSE OBSERVED DURING THE PERFORMANCE OF THIS TEST HOWEVER CANNOT BE RESPONSIBLE FOR INACCURATE READINGS WHICH MAY BE EXPERIENCED IN FUTURE USES DUE TO CONDITIONS WHICH

ARE BEYOND OUR CONTROL.

THIS CALIBRATION WAS PERFORMED BY: DEBORAH M. WEBER

THE CALIBRATION PERFORMED AND DOCUMENTED BY THIS REPORT OF TEST IS A LIMITED CALIBRATION AND ACCORDINGLY, LIMITATIONS OF USE ARE IMPOSED AS FOLLOWS:

THIS INSTRUMENT CAN BE USED WITH CONFIDENCE ONLY WITHIN THE RANGE BRACKETED BY THE TEST POINTS AND/OR IMMEDIATELY AROUND THE TEST POINTS.

TRACEABILITY INFORMATION

The NIST primary reference standard(s), transfer standard(s) and, (if applicable), comparator(s) used in this test are listed below:

TEMP: 33.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-12
TEMP: 34.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-12
TEMP: 35.00°C Reference: NIST SPRT S/N 1085, Transfer standards: 576776 & 24453 Comparator: PolyScience water bath MTE-12

THE NIST REFERENCE THERMOMETER REFERRED TO ABOVE IS A STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT), CALIBRATED BY NIST IN APRIL, 2002. ICL HAS SPECIFIED A ONE YEAR PERIOD OF VALIDITY FOR THIS CALIBRATION. ALL PRT TRANSFER STANDARDS WERE CALIBRATED AGAINST THIS SPRT IN JANUARY OF 2003, AND ARE ON A SIX MONTH CALIBRATION INTERVAL. LIQUID IN GLASS TRANSFER STANDARDS WERE CALIBRATED IN JULY OF 2002 AGAINST THIS SPRT AND ARE ON A ONE YEAR CALIBRATION INTERVAL.

THE EXPANDED UNCERTAINTIES (K=2) PROVIDED BY NIST FOR THIS SPRT CALIBRATION ARE AS FOLLOWS: -195.6 to <0C: +/- 0.0023C; 0.01C: +/- .0014C; >0 to 95C: +/- 0.0024C; >95C to 300C: +/- 0.0048C; >300 to 420C: +/- 0.0075C

ICL CALIBRATION LABORATORIES, INC.

An ISO/IEC 17025 & ANSI/NCSL Z-540-1 accredited laboratory - American Association for Laboratory Accreditation Certificate #526.01

Bruce Markey

J. JEFF KELLY, TECHNICAL DIRECTOR
DEBORAH M. WEBER, A.S.C.P. ACCREDITED TECHNOLOGIST
BRUCE MARKEY, V.P. TECHNICAL SERVICES

Karen Alleborn

This document prepared by LORI PARR and reviewed by KAREN ALLEBORN

DATE REPORT ISSUED: 07-28-2003 RECOMMENDED RECALIBRATION DATE: July 28, 2004

NIST GMP-11 (Mar '03), 'Good Measurement Practice for Assignment and Adjustment of Calibration Intervals for Standards' states that, 'Temperature standards are dynamic with use. Shock, contamination and other factors can cause drift from accepted values'. Table 4 of GMP-11 recommends recalibration of liquid-in-glass thermometers, standard thermistors and PRTs at 12 month intervals. Liquid-in-glass thermometers used for 'Temperature Critical Parameters' should be recalibrated at 6 month intervals. NIST GMP-11 is available in Adobe .pdf format on our website at www.icllabs.com Follow the link for 'Downloads'.

The API 'Manual of Petroleum Measurement Standards', Chapter 7, June, 2001, specifies a 12 month recalibration interval for glass thermometers (see P. 8.3) and for portable electronic thermometers (see P.8.2).

The user should be aware that any number of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

This report applies only to the item calibrated.

NIST CENTENNIAL 1901-1991

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-

Demarre
EXHIBIT NO. 42
9-9-04
M. Green

REPORT OF TEST

Platinum Resistance Thermometer
Hart Scientific Model 5682
S/N 1035

Submitted by

ICL Calibration Laboratories, Inc.
Stuart, Florida

A platinum resistance thermometer (Model 5682, S/N 1035), was calibrated by comparison with a standard platinum resistance thermometer (SPRT) in stirred liquid calibration baths at four temperatures. The sensor and SPRT were immersed to a depth of 30 cm. A triple point of water (TPW) was measured by immersing the probe 26.5 cm in a TPW cell. A continuous measuring current of 1 mA was used in the measurements. The results obtained are:

Bath Temperature °C	Resistance Ω
−195.868	18.9405
−38.802	85.1412
0.01 (TPW)	100.8384
231.912	190.8247
419.506	258.9729

The expanded uncertainty (k=2) in the bath temperature measurement of − 195.8 °C does not exceed 2.3 m °C, of −38.8 °C does not exceed 2.3 m °C, for the range of 95 °C to 300 °C does not exceed 4.8 m °C, for the range of 300 °C to 550 °C does not exceed 7.5 m °C; and for the TPW, 0.04 m °C. For a discussion of the uncertainty, see NIST TN 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results," NIST TN 1411 "Reproducibility of the Temperature of the Ice Point in Routine Measurements," and NISTIR 6225, "A New NIST Automated Calibration System for Industrial-Grade Platinum Resistance Thermometers."

All temperatures in this report are on the International Temperature Scale of 1990 (ITS-90). This temperature scale was adopted by the International Committee of Weights and Measures at its meeting in September, 1989, and is described in "The International Temperature Scale of 1990", Metrologia 27, No. 1, 3-10 (1990); Metrologia 27, 107 (1990).

For the Director
National Institute of Standards and Technology

Dean Ripple

Dr. Dean Ripple
Leader, Thermometry Group
Process Measurements Division

Test No.: 264829-01
Completed: May 9, 2001
P.O. No.: 66629

NIST

NIST CENTENNIAL 1901-2001

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-

REPORT OF TEST

Platinum Resistance Thermometer
Hart Scientific Model 5680
S/N 1085

Submitted by

ICL Calibration Laboratories, Inc.
Stuart, Florida

A platinum resistance thermometer (Model 5680, S/N 1085), was calibrated by comparison with a standard platinum resistance thermometer (SPRT) in stirred liquid calibration baths at four temperatures. The sensor and SPRT were immersed to a depth of 30 cm. A triple point of water (TPW) was measured by immersing the probe 26.5 cm in a TPW cell. A continuous measuring current of 1 mA was used in the measurements. The results obtained are:

Bath Temperature °C	Resistance Ω
−195.640	4.7778
−38.806	21.3764
0.01 (TPW)	25.3182
231.906	47.9169
419.506	65.0330

The expanded uncertainty (k=2) in the bath temperature measurement of −195.6 °C does not exceed 2.3 m °C, of −38.8 °C does not exceed 2.3 m °C, for the range of 95 °C to 300 °C does not exceed 4.8 m °C, for the range of 300 °C to 550 °C does not exceed 7.5 m °C ; and for the TPW, 0.04 m °C. For a discussion of the uncertainty, see NIST TN 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results," NIST TN 1411 "Reproducibility of the Temperature of the Ice Point in Routine Measurements," and NISTIR 6225, "A New NIST Automated Calibration System for Industrial-Grade Platinum Resistance Thermometers."

All temperatures in this report are on the International Temperature Scale of 1990 (ITS-90). This temperature scale was adopted by the International Committee of Weights and Measures at its meeting in September, 1989, and is described in "The International Temperature Scale of 1990", Metrologia 27, No. 1, 3-10 (1990); Metrologia 27, 107 (1990).

For the Director
National Institute of Standards and Technology

Dean Ripple

Dr. Dean Ripple
Leader, Thermometry Group
Process Measurements Division

Test No.: 266710-02
Completed: April 10, 2002
P.O. No.: 67086

NIST

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-

REPORT OF TEST

Platinum Resistance Thermometer
Hart Scientific Model 5680
S/N 1085

Submitted by

ICL Calibration Laboratories, Inc.
Stuart, Florida

A platinum resistance thermometer (Model 5680, S/N 1085), was calibrated by comparison with a standard platinum resistance thermometer (SPRT) in stirred liquid calibration baths at four temperatures. The sensor and SPRT were immersed to a depth of 30 cm. A triple point of water (TPW) was measured by immersing the probe 26.5 cm in a TPW cell. A continuous measuring current of 1 mA was used in the measurements. The results obtained are:

Bath Temperature °C	Resistance Ω
−195.643	4.7769
−38.799	21.3756
0.01 (TPW)	25.3170
231.962	47.9191
419.559	65.0323

The expanded uncertainty (k=2) in the bath temperature measurement of − 195.6 °C does not exceed 2.3 m °C, of −38.8 °C does not exceed 2.3 m °C, for the range of 95 °C to 300 °C does not exceed 4.8 m °C, for the range of 300 °C to 550 °C does not exceed 7.5 m °C ; and for the TPW, 1.4 m °C. For a discussion of the uncertainty, see NIST TN 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results," NIST TN 1411 "Reproducibility of the Temperature of the Ice Point in Routine Measurements," and NISTIR 6225, "A New NIST Automated Calibration System for Industrial-Grade Platinum Resistance Thermometers."

All temperatures in this report are on the International Temperature Scale of 1990 (ITS-90). This temperature scale was adopted by the International Committee of Weights and Measures at its meeting in September, 1989, and is described in "The International Temperature Scale of 1990", Metrologia 27, No. 1, 3-10 (1990); Metrologia 27, 107 (1990).

For the Director
National Institute of Standards and Technology

Dr. Dean Ripple
Leader, Thermometry Group
Process Measurements Division

Test No.: 263085-00
Completed: April 19, 2000
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NIST

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899

REPORT OF CALIBRATION

International Temperature Scale of 1990

Standard Platinum Resistance Thermometer
Hart Scientific Model 5699
Serial Number 0159

Submitted by:
ICL Calibration Laboratories, Inc.
Stuart, FL 34994

This standard platinum resistance thermometer (SPRT) was calibrated with an AC bridge operating at a frequency of 30 Hz and with continuous measuring currents of 1.0 mA and 1.414 mA. In accordance with the International Temperature Scale of 1990 (ITS-90) that was officially adopted by the Comite′ International des Poids et Mesures (CIPM) in September 1989, the subranges from 83.8058 K to 273.16 K and 273.15 K to 692.677 K, with the following fixed points and their stated expanded uncertainties ($k = 2$), were used to calibrate the thermometer. For a description of the uncertainties, see NISTIR 5319, 16 pp., (1994), entitled "*Assessment of Uncertainties of Calibration of Resistance Thermometers at the National Institute of Standards and Technology.*"

Fixed Point		**Temperature**		**Expanded Uncertainty where $k = 2$ (mK)**
		T_{90} (K)	t_{90} (°C)	
Ar	TP	83.8058	−189.3442	0.08
Hg	TP	234.3156	−38.8344	0.15
H_2O	TP	273.16	0.01	0.02
Sn	FP	505.078	231.928	0.24
Zn	FP	692.677	419.527	0.41

The following values were determined for the coefficients of the pertinent deviation functions of the ITS-90, as given in the attached material describing the scale. The attached tables were generated using these values.

Coefficients for Zero-Power Dissipation Calibration

$a_4 =$ −8.1949689E-05 $a_8 =$ −1.0087772E-04
$b_4 =$ −1.6559779E-06 $b_8 =$ −7.2796096E-06

Coefficients for 1 mA Calibration

$a_4 =$ −8.4240654E-05 $a_8 =$ −1.0147545E-04
$b_4 =$ −2.3376083E-06 $b_8 =$ −7.7646210E-06

The resistance of this thermometer at 273.16 K was calculated to be 25.4670 Ω at zero-power dissipation and 25.4670 Ω at 1 mA. During calibration, the resistance at 273.16 K changed by the equivalent of 0.3 mK at zero-power dissipation and 0.3 mK at 1 mA.

This thermometer is satisfactory as a defining instrument of the ITS-90 in accordance with the criteria that W(302.9146 K) ≥ 1.118 07 or W(234.3156 K) ≤ 0.844 235.

For the Director,
National Institute of Standards and Technology

Dean C. Ripple
Leader, Thermometry Group
Process Measurements Division

October 7, 2003
Test No.: 836/269257-03
Purchase Order No.: 68157

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United States Department of Con...erce
Technology Administration
National Institute of Standards and Technology

NIST Technical Note 1297
1994 Edition

Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results

Barry N. Taylor and Chris E. Kuyatt

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EXHIBIT

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Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results

Barry N. Taylor and Chris E. Kuyatt

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National Institute of Standards and Technology
Gaithersburg, MD 20899-0001

(Supersedes NIST Technical Note 1297, January 1993)

September 1994

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Preface to the 1994 Edition

The previous edition, which was the first, of this National Institute of Standards and Technology (NIST) Technical Note (TN 1297) was initially published in January 1993. A second printing followed shortly thereafter, and in total some 10 000 copies were distributed to individuals at NIST and in both the United States at large and abroad — to metrologists, scientists, engineers, statisticians, and others who are concerned with measurement and the evaluation and expression of the uncertainty of the result of a measurement. On the whole, these individuals gave TN 1297 a very positive reception. We were, of course, pleased that a document intended as a guide to NIST staff was also considered to be of significant value to the international measurement community.

Several of the recipients of the 1993 edition of TN 1297 asked us questions concerning some of the points it addressed and some it did not. In view of the nature of the subject of evaluating and expressing measurement uncertainty and the fact that the principles presented in TN 1297 are intended to be applicable to a broad range of measurements, such questions were not at all unexpected.

It soon occurred to us that it might be helpful to the current and future users of TN 1297 if the most important of these questions were addressed in a new edition. To this end, we have added to the 1993 edition of TN 1297 a new appendix — Appendix D — which attempts to clarify and give additional guidance on a number of topics, including the use of certain terms such as accuracy and precision. We hope that this new appendix will make this 1994 edition of TN 1297 even more useful than its predecessor.

We also took the opportunity provided us by the preparation of a new edition of TN 1297 to make very minor word changes in a few portions of the text. These changes were made in order to recognize the official publication in October 1993 of the ISO *Guide to the Expression of Uncertainty in Measurement* on which TN 1297 is based (for example, the reference to the *Guide* was updated); and to bring TN 1297 into full harmony with the *Guide* (for example, "estimated correction" has been changed to simply "correction," and "can be asserted to lie" has been changed to "is believed to lie").

September 1994

Barry N. Taylor

Chris E. Kuyatt

FOREWORD
(to the 1993 Edition)

Results of measurements and conclusions derived from them constitute much of the technical information produced by NIST. It is generally agreed that the usefulness of measurement results, and thus much of the information that we provide as an institution, is to a large extent determined by the quality of the statements of uncertainty that accompany them. For example, only if quantitative and thoroughly documented statements of uncertainty accompany the results of NIST calibrations can the users of our calibration services establish their level of traceability to the U.S. standards of measurement maintained at NIST.

Although the vast majority of NIST measurement results are accompanied by quantitative statements of uncertainty, there has never been a uniform approach at NIST to the expression of uncertainty. The use of a single approach within the Institute rather than many different approaches would ensure the consistency of our outputs, thereby simplifying their interpretation.

To address this issue, in July 1992 I appointed a NIST Ad Hoc Committee on Uncertainty Statements and charged it with recommending to me a NIST policy on this important topic. The members of the Committee were:

D. C. Cranmer
Materials Science and Engineering Laboratory

K. R. Eberhardt
Computing and Applied Mathematics Laboratory

R. M. Judish
Electronics and Electrical Engineering Laboratory

R. A. Kamper
Office of the Director, NIST/Boulder Laboratories

C. E. Kuyatt
Physics Laboratory

J. R. Rosenblatt
Computing and Applied Mathematics Laboratory

J. D. Simmons
Technology Services

L. E. Smith
Office of the Director, NIST; Chair

D. A. Swyt
Manufacturing Engineering Laboratory

B. N. Taylor
Physics Laboratory

R. L. Watters
Chemical Science and Technology Laboratory

This action was motivated in part by the emerging international consensus on the approach to expressing uncertainty in measurement recommended by the International Committee for Weights and Measures (CIPM). The movement toward the international adoption of the CIPM approach for expressing uncertainty is driven to a large extent by the global economy and marketplace; its worldwide use will allow measurements performed in different countries and in sectors as diverse as science, engineering, commerce, industry, and regulation to be more easily understood, interpreted, and compared.

At my request, the Ad Hoc Committee carefully reviewed the needs of NIST customers regarding statements of uncertainty and the compatibility of those needs with the CIPM approach. It concluded that the CIPM approach could be used to provide quantitative expressions of measurement uncertainty that would satisfy our customers' requirements. The Ad Hoc Committee then recommended to me a specific policy for the implementation of that approach at NIST. I enthusiastically accepted its recommendation and the policy has been incorporated in the NIST Administrative Manual. (It is also included in this Technical Note as Appendix C.)

To assist the NIST staff in putting the policy into practice, two members of the Ad Hoc Committee prepared this Technical Note. I believe that it provides a helpful discussion of the CIPM approach and, with its aid, that the NIST policy can be implemented without excessive difficulty. Further, I believe that because NIST statements of uncertainty resulting from the policy will be uniform among themselves and consistent with current international practice, the policy will help our customers increase their competitiveness in the national and international marketplaces.

January 1993

John W. Lyons
Director,
National Institute of Standards and Technology

GUIDELINES FOR EVALUATING AND EXPRESSING THE UNCERTAINTY OF NIST MEASUREMENT RESULTS

1. Introduction

1.1 In October 1992, a new policy on expressing measurement uncertainty was instituted at NIST. This policy is set forth in "Statements of Uncertainty Associated With Measurement Results," Appendix E, NIST Technical Communications Program, Subchapter 4.09 of the Administrative Manual (reproduced as Appendix C of these *Guidelines*).

1.2 The new NIST policy is based on the approach to expressing uncertainty in measurement recommended by the CIPM[1] in 1981 [1] and the elaboration of that approach given in the *Guide to the Expression of Uncertainty in Measurement* (hereafter called the *Guide*), which was prepared by individuals nominated by the BIPM, IEC, ISO, or OIML [2].[1] The CIPM approach is founded on Recommendation INC-1 (1980) of the Working Group on the Statement of Uncertainties [3]. This group was convened in 1980 by the BIPM as a consequence of a 1977[2] request by the CIPM that the BIPM study the question of reaching an international consensus on expressing uncertainty in measurement. The request was initiated by then CIPM member and NBS Director E. Ambler. A 1985[2] request by the CIPM to ISO asking it to develop a broadly applicable guidance document based on Recommendation INC-1 (1980) led to the development of the *Guide*. It is at present the most complete reference on the general application of the CIPM approach to expressing measurement uncertainty, and its development is giving further impetus to the worldwide adoption of that approach.

1.3 Although the *Guide* represents the current international view of how to express uncertainty in measurement based on the CIPM approach, it is a rather lengthy document. We have therefore prepared this Technical Note with the goal of succinctly presenting, in the context of the new NIST policy, those aspects of the *Guide* that will be of most use to the NIST staff in implementing that policy. We have also included some suggestions that are not contained in the *Guide* or policy but which we believe are useful. *However, none of the guidance given in this Technical Note is to be interpreted as NIST policy unless it is directly quoted from the policy itself.* Such cases will be clearly indicated in the text.

1.4 The guidance given in this Technical Note is intended to be applicable to most, if not all, NIST measurement results, including results associated with

- international comparisons of measurement standards,
- basic research,
- applied research and engineering,
- calibrating client measurement standards,
- certifying standard reference materials, and
- generating standard reference data.

Since the *Guide* itself is intended to be applicable to similar kinds of measurement results, it may be consulted for additional details. Classic expositions of the statistical evaluation of measurement processes are given in references [4-7].

2. Classification of Components of Uncertainty

2.1 In general, the result of a measurement is only an approximation or estimate of the value of the specific quantity subject to measurement, that is, the **measurand**, and thus the result is complete only when accompanied by a quantitative statement of its uncertainty.

2.2 The uncertainty of the result of a measurement generally consists of several components which, in the CIPM approach, may be grouped into two categories according to the method used to estimate their numerical values:

A. those which are evaluated by statistical methods,

B. those which are evaluated by other means.

2.3 There is not always a simple correspondence between the classification of uncertainty components into categories A and B and the commonly used classification of uncertainty components as "random" and "systematic." The nature of an uncertainty component is conditioned by the use made of the corresponding quantity, that is, on how that

[1]CIPM: International Committee for Weights and Measures; BIPM: International Bureau of Weights and Measures; IEC: International Electrotechnical Commission; ISO: International Organization for Standardization; OIML: International Organization of Legal Metrology.

[2]These dates have been corrected from those in the first (1993) edition of TN 1297 and in the *Guide*.

quantity appears in the mathematical model that describes the measurement process. When the corresponding quantity is used in a different way, a "random" component may become a "systematic" component and vice versa. Thus the terms "random uncertainty" and "systematic uncertainty" can be misleading when generally applied. An alternative nomenclature that might be used is

"component of uncertainty arising from a random effect,"

"component of uncertainty arising from a systematic effect,"

where a random effect is one that gives rise to a possible random error in the *current measurement process* and a systematic effect is one that gives rise to a possible systematic error in the current measurement process. In principle, an uncertainty component arising from a systematic effect may in some cases be evaluated by method A while in other cases by method B (see subsection 2.2), as may be an uncertainty component arising from a random effect.

NOTE – The difference between error and uncertainty should always be borne in mind. For example, the result of a measurement after correction (see subsection 5.2) can unknowably be very close to the unknown value of the measurand, and thus have negligible error, even though it may have a large uncertainty (see the *Guide* [2]).

2.4 Basic to the CIPM approach is representing each component of uncertainty that contributes to the uncertainty of a measurement result by an estimated standard deviation, termed **standard uncertainty** with suggested symbol u_i, and equal to the positive square root of the estimated variance u_i^2.

2.5 It follows from subsections 2.2 and 2.4 that an uncertainty component in category A is represented by a statistically estimated standard deviation s_i, equal to the positive square root of the statistically estimated variance s_i^2, and the associated number of degrees of freedom ν_i. For such a component the standard uncertainty is $u_i = s_i$.

The evaluation of uncertainty by the statistical analysis of series of observations is termed a **Type A evaluation (of uncertainty)**.

2.6 In a similar manner, an uncertainty component in category B is represented by a quantity u_j, which may be considered an approximation to the corresponding standard deviation; it is equal to the positive square root of u_j^2, which may be considered an approximation to the corresponding variance and which is obtained from an assumed probability distribution based on all the available information (see section 4). Since the quantity u_j^2 is treated like a variance and u_j like a standard deviation, for such a component the standard uncertainty is simply u_j.

The evaluation of uncertainty by means other than the statistical analysis of series of observations is termed a **Type B evaluation (of uncertainty)**.

2.7 Correlations between components (of either category) are characterized by estimated covariances [see Appendix A, Eq. (A-3)] or estimated correlation coefficients.

3. Type A Evaluation of Standard Uncertainty

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. Examples are calculating the standard deviation of the mean of a series of independent observations [see Appendix A, Eq. (A-5)]; using the method of least squares to fit a curve to data in order to estimate the parameters of the curve and their standard deviations; and carrying out an analysis of variance (ANOVA) in order to identify and quantify random effects in certain kinds of measurements. If the measurement situation is especially complicated, one should consider obtaining the guidance of a statistician. The NIST staff can consult and collaborate in the development of statistical experiment designs, analysis of data, and other aspects of the evaluation of measurements with the Statistical Engineering Division, Computing and Applied Mathematics Laboratory. Inasmuch as this Technical Note does not attempt to give detailed statistical techniques for carrying out Type A evaluations, references [4-7], and reference [8] in which a general approach to quality control of measurement systems is set forth, should be consulted for basic principles and additional references.

4. Type B Evaluation of Standard Uncertainty

4.1 A Type B evaluation of standard uncertainty is usually based on scientific judgment using all the relevant information available, which may include

- previous measurement data,
- experience with, or general knowledge of, the behavior and property of relevant materials and instruments,
- manufacturer's specifications,
- data provided in calibration and other reports, and
- uncertainties assigned to reference data taken from handbooks.

Some examples of Type B evaluations are given in subsections 4.2 to 4.6.

4.2 Convert a quoted uncertainty that is a stated multiple of an estimated standard deviation to a standard uncertainty by dividing the quoted uncertainty by the multiplier.

4.3 Convert a quoted uncertainty that defines a "confidence interval" having a stated level of confidence (see subsection 5.5), such as 95 or 99 percent, to a standard uncertainty by treating the quoted uncertainty as if a normal distribution had been used to calculate it (unless otherwise indicated) and dividing it by the appropriate factor for such a distribution. These factors are 1.960 and 2.576 for the two levels of confidence given (see also the last line of Table B.1 of Appendix B).

4.4 Model the quantity in question by a normal distribution and estimate lower and upper limits a_- and a_+ such that the best estimated value of the quantity is $(a_+ + a_-)/2$ (i.e., the center of the limits) and there is 1 chance out of 2 (i.e., a 50 percent probability) that the value of the quantity lies in the interval a_- to a_+. Then $u_j \approx 1.48a$, where $a = (a_+ - a_-)/2$ is the half-width of the interval.

4.5 Model the quantity in question by a normal distribution and estimate lower and upper limits a_- and a_+ such that the best estimated value of the quantity is $(a_+ + a_-)/2$ and there is about a 2 out of 3 chance (i.e., a 67 percent probability) that the value of the quantity lies in the interval a_- to a_+. Then $u_j \approx a$, where $a = (a_+ - a_-)/2$.

4.6 Estimate lower and upper limits a_- and a_+ for the value of the quantity in question such that the probability that the value lies in the interval a_- to a_+ is, for all practical purposes, 100 percent. Provided that there is no contradictory information, treat the quantity as if it is equally probable for its value to lie anywhere within the interval a_- to a_+; that is, model it by a uniform or rectangular probability distribution. The best estimate of the value of the quantity is then $(a_+ + a_-)/2$ with $u_j = a/\sqrt{3}$, where $a = (a_+ - a_-)/2$.

If the distribution used to model the quantity is triangular rather than rectangular, then $u_j = a/\sqrt{6}$.

If the quantity in question is modeled by a normal distribution as in subsections 4.4 and 4.5, there are no finite limits that will contain 100 percent of its possible values. However, plus and minus 3 standard deviations about the mean of a normal distribution corresponds to 99.73 percent limits. Thus, if the limits a_- and a_+ of a normally distributed quantity with mean $(a_+ + a_-)/2$ are considered to contain "almost all" of the possible values of the quantity, that is, approximately 99.73 percent of them, then $u_j \approx a/3$, where $a = (a_+ - a_-)/2$.

The rectangular distribution is a reasonable default model in the absence of any other information. But if it is known that values of the quantity in question near the center of the limits are more likely than values close to the limits, a triangular or a normal distribution may be a better model.

4.7 Because the reliability of evaluations of components of uncertainty depends on the quality of the information available, it is recommended that all parameters upon which the measurand depends be varied to the fullest extent practicable so that the evaluations are based as much as possible on observed data. Whenever feasible, the use of empirical models of the measurement process founded on long-term quantitative data, and the use of check standards and control charts that can indicate if a measurement process is under statistical control, should be part of the effort to obtain reliable evaluations of components of uncertainty [8]. Type A evaluations of uncertainty based on limited data are not necessarily more reliable than soundly based Type B evaluations.

5. Combined Standard Uncertainty

5.1 The **combined standard uncertainty** of a measurement result, suggested symbol u_c, is taken to represent the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties u_i (and covariances as appropriate), whether arising from a Type A evaluation or a Type B evaluation, using the usual method for combining standard deviations. This method, which is summarized in Appendix A [Eq. (A-3)], is often called the *law of propagation of uncertainty* and in common parlance the "root-sum-of-squares" (square root of the sum-of-the-squares) or "RSS" method of combining uncertainty components estimated as standard deviations.

NOTE – The NIST policy also allows the use of established and documented methods equivalent to the "RSS" method, such as the numerically based "bootstrap" (see Appendix C).

5.2 It is assumed that a correction (or correction factor) is applied to compensate for each recognized systematic effect that significantly influences the measurement result and that every effort has been made to identify such effects. The relevant uncertainty to associate with each recognized systematic effect is then the standard uncertainty of the applied correction. The correction may be either positive, negative, or zero, and its standard uncertainty may in some cases be obtained from a Type A evaluation while in other cases by a Type B evaluation.

NOTES

1 The uncertainty of a correction applied to a measurement result to compensate for a systematic effect is not the systematic error in the measurement result due to the effect. Rather, it is a measure of the uncertainty of the result due to incomplete knowledge of the required value of the correction. The terms "error" and "uncertainty" should not be confused (see also the note of subsection 2.3).

2 Although it is strongly recommended that corrections be applied for all recognized significant systematic effects, in some cases it may not be practical because of limited resources. Nevertheless, the expression of uncertainty in such cases should conform with these guidelines to the fullest possible extent (see the *Guide* [2]).

5.3 The combined standard uncertainty u_c is a widely employed measure of uncertainty. The NIST policy on expressing uncertainty states that (see Appendix C):

> Commonly, u_c is used for reporting results of determinations of fundamental constants, fundamental metrological research, and international comparisons of realizations of SI units.

Expressing the uncertainty of NIST's primary cesium frequency standard as an estimated standard deviation is an example of the use of u_c in fundamental metrological research. It should also be noted that in a 1986 recommendation [9], the CIPM requested that what is now termed combined standard uncertainty u_c be used "by all participants in giving the results of all international comparisons or other work done under the auspices of the CIPM and Comités Consultatifs."

5.4 In many practical measurement situations, the probability distribution characterized by the measurement result y and its combined standard uncertainty $u_c(y)$ is approximately normal (Gaussian). When this is the case and $u_c(y)$ itself has negligible uncertainty (see Appendix B), $u_c(y)$ defines an interval $y - u_c(y)$ to $y + u_c(y)$ about the measurement result y within which the value of the measurand Y estimated by y is believed to lie with a level of confidence of approximately 68 percent. That is, it is believed with an approximate level of confidence of 68 percent that $y - u_c(y) \leq Y \leq y + u_c(y)$, which is commonly written as $Y = y \pm u_c(y)$.

The probability distribution characterized by the measurement result and its combined standard uncertainty is approximately normal when the conditions of the Central Limit Theorem are met. This is the case, often encountered in practice, when the estimate y of the measurand Y is not determined directly but is obtained from the estimated values of a significant number of other quantities [see Appendix A, Eq. (A-1)] describable by well-behaved probability distributions, such as the normal and rectangular distributions; the standard uncertainties of the estimates of these quantities contribute comparable amounts to the combined standard uncertainty $u_c(y)$ of the measurement result y; and the linear approximation implied by Eq. (A-3) in Appendix A is adequate.

NOTE – If $u_c(y)$ has non-negligible uncertainty, the level of confidence will differ from 68 percent. The procedure given in Appendix B has been proposed as a simple expedient for approximating the level of confidence in these cases.

5.5 The term "confidence interval" has a specific definition in statistics and is only applicable to intervals based on u_c when certain conditions are met, including that all components of uncertainty that contribute to u_c be obtained from Type A evaluations. Thus, in these guidelines, an interval based on u_c is viewed as encompassing a fraction p of the probability distribution characterized by the measurement result and its combined standard uncertainty, and p is the *coverage probability* or *level of confidence* of the interval.

6. Expanded Uncertainty

6.1 Although the combined standard uncertainty u_c is used to express the uncertainty of many NIST measurement results, for some commercial, industrial, and regulatory applications of NIST results (e.g., when health and safety are concerned), what is often required is a measure of uncertainty that defines an interval about the measurement result y within which the value of the measurand Y is confidently believed to lie. The measure of uncertainty intended to meet this requirement is termed **expanded uncertainty**, suggested symbol U, and is obtained by multiplying $u_c(y)$ by a **coverage factor**, suggested symbol k. Thus $U = ku_c(y)$ and it is confidently believed that $y - U \leq Y \leq y + U$, which is commonly written as $Y = y \pm U$.

It is to be understood that subsection 5.5 also applies to the interval defined by expanded uncertainty U.

6.2 In general, the value of the coverage factor k is chosen on the basis of the desired level of confidence to be associated with the interval defined by $U = ku_c$. Typically, k is in the range 2 to 3. When the normal distribution applies and u_c has negligible uncertainty (see subsection 5.4), $U = 2u_c$ (i.e., $k = 2$) defines an interval having a level of confidence of approximately 95 percent, and $U = 3u_c$

(i.e., $k = 3$) defines an interval having a level of confidence greater than 99 percent.

NOTE – For a quantity z described by a normal distribution with expectation μ_z and standard deviation σ, the interval $\mu_z \pm k\sigma$ encompasses 68.27, 90, 95.45, 99, and 99.73 percent of the distribution for $k = 1$, $k = 1.645$, $k = 2$, $k = 2.576$, and $k = 3$, respectively (see the last line of Table B.1 of Appendix B).

6.3 Ideally, one would like to be able to choose a specific value of k that produces an interval corresponding to a well-defined level of confidence p, such as 95 or 99 percent; equivalently, for a given value of k, one would like to be able to state unequivocally the level of confidence associated with that interval. This is difficult to do in practice because it requires knowing in considerable detail the probability distribution of each quantity upon which the measurand depends and combining those distributions to obtain the distribution of the measurand.

NOTE – The more thorough the investigation of the possible existence of non-trivial systematic effects and the more complete the data upon which the estimates of the corrections for such effects are based, the closer one can get to this ideal (see subsections 4.7 and 5.2).

6.4 The CIPM approach does not specify how the relation between k and p is to be established. The *Guide* [2] and Dietrich [10] give an approximate solution to this problem (see Appendix B); it is possible to implement others which also approximate the result of combining the probability distributions assumed for each quantity upon which the measurand depends, for example, solutions based on numerical methods.

6.5 In light of the discussion of subsections 6.1 - 6.4, and in keeping with the practice adopted by other national standards laboratories and several metrological organizations, the stated NIST policy is (see Appendix C):

> Use expanded uncertainty U to report the results of all NIST measurements other than those for which u_c has traditionally been employed. To be consistent with current international practice, the value of k to be used at NIST for calculating U is, by convention, $k = 2$. Values of k other than 2 are only to be used for specific applications dictated by established and documented requirements.

An example of the use of a value of k other than 2 is taking k equal to a t-factor obtained from the t-distribution when u_c has low degrees of freedom in order to meet the dictated requirement of providing a value of $U = ku_c$ that defines an interval having a level of confidence close to 95 percent. (See Appendix B for a discussion of how a value of k that produces such a value of U might be approximated.)

6.6 The NIST policy provides for exceptions as follows (see Appendix C):

> It is understood that any valid statistical method that is technically justified under the existing circumstances may be used to determine the equivalent of u_i, u_c, or U. Further, it is recognized that international, national, or contractual agreements to which NIST is a party may occasionally require deviation from NIST policy. In both cases, the report of uncertainty must document what was done and why.

7. Reporting Uncertainty

7.1 The stated NIST policy regarding reporting uncertainty is (see Appendix C):

> Report U together with the coverage factor k used to obtain it, or report u_c.
>
> When reporting a measurement result and its uncertainty, include the following information in the report itself or by referring to a published document:
>
> – A list of all components of standard uncertainty, together with their degrees of freedom where appropriate, and the resulting value of u_c. The components should be identified according to the method used to estimate their numerical values:
>
> A. those which are evaluated by statistical methods,
>
> B. those which are evaluated by other means.
>
> – A detailed description of how each component of standard uncertainty was evaluated.
>
> – A description of how k was chosen when k is not taken equal to 2.
>
> It is often desirable to provide a probability interpretation, such as a level of confidence, for the interval defined by U or u_c. When this is done, the basis for such a statement must be given.

7.2 The NIST requirement that a full description of what was done be given is in keeping with the generally accepted view that when reporting a measurement result and its uncertainty, it is preferable to err on the side of providing too much information rather than too little. However, when such details are provided to the users of NIST measurement results by referring to published documents, which is often the case when such results are given in calibration and test reports and certificates, it is imperative that the referenced documents be kept up-to-date so that they are consistent with the measurement process in current use.

7.3 The last paragraph of the NIST policy on reporting uncertainty (see subsection 7.1 above) refers to the desirability of providing a probability interpretation, such as a level of confidence, for the interval defined by U or u_c. The following examples show how this might be done when the numerical result of a measurement and its assigned uncertainty is reported, assuming that the published detailed description of the measurement provides a sound basis for the statements made. (In each of the three cases, the quantity whose value is being reported is assumed to be a nominal 100 g standard of mass m_s.)

$m_s = (100.021\ 47 \pm 0.000\ 70)$ g, where the number following the symbol ± is the numerical value of an expanded uncertainty $U = ku_c$, with U determined from a combined standard uncertainty (i.e., estimated standard deviation) $u_c = 0.35$ mg and a coverage factor $k = 2$. Since it can be assumed that the possible estimated values of the standard are approximately normally distributed with approximate standard deviation u_c, the unknown value of the standard is believed to lie in the interval defined by U with a level of confidence of approximately 95 percent.

$m_s = (100.021\ 47 \pm 0.000\ 79)$ g, where the number following the symbol ± is the numerical value of an expanded uncertainty $U = ku_c$, with U determined from a combined standard uncertainty (i.e., estimated standard deviation) $u_c = 0.35$ mg and a coverage factor $k = 2.26$ based on the t-distribution for $\nu = 9$ degrees of freedom, and defines an interval within which the unknown value of the standard is believed to lie with a level of confidence of approximately 95 percent.

$m_s = 100.021\ 47$ g with a combined standard uncertainty (i.e., estimated standard deviation) of $u_c = 0.35$ mg. Since it can be assumed that the possible estimated values of the standard are approximately normally distributed with approximate standard deviation u_c, the unknown value of the standard is believed to lie in the interval $m_s \pm u_c$ with a level of confidence of approximately 68 percent.

When providing such probability interpretations of the intervals defined by U and u_c, subsection 5.5 should be recalled. In this regard, the interval defined by U in the second example might be a conventional confidence interval (at least approximately) if all the components of uncertainty are obtained from Type A evaluations.

7.4 Some users of NIST measurement results may automatically interpret $U = 2u_c$ and u_c as quantities that define intervals having levels of confidence corresponding to those of a normal distribution, namely, 95 percent and 68 percent, respectively. Thus, when reporting either $U = 2u_c$ or u_c, if it is known that the interval which $U = 2u_c$ or u_c defines has a level of confidence that differs significantly from 95 percent or 68 percent, it should be so stated as an aid to the users of the measurement result. In keeping with the NIST policy quoted in subsection 6.5, when the measure of uncertainty is expanded uncertainty U, one may use a value of k that does lead to a value of U that defines an interval having a level of confidence of 95 percent if such a value of U is necessary for a specific application dictated by an established and documented requirement.

7.5 In general, it is not possible to know in detail all of the uses to which a particular NIST measurement result will be put. Thus, it is usually inappropriate to include in the uncertainty reported for a NIST result any component that arises from a NIST assessment of how the result might be employed; the quoted uncertainty should normally be the actual uncertainty obtained at NIST.

7.6 It follows from subsection 7.5 that for standards sent by customers to NIST for calibration, the quoted uncertainty should not normally include estimates of the uncertainties that may be introduced by the return of the standard to the customer's laboratory or by its use there as a reference standard for other measurements. Such uncertainties are due, for example, to effects arising from transportation of the standard to the customer's laboratory, including mechanical damage; the passage of time; and differences between the environmental conditions at the customer's laboratory and at NIST. A caution may be added to the reported uncertainty if any such effects are likely to be significant and an additional uncertainty for them may be estimated and quoted. If, for the convenience of the customer, this additional uncertainty is combined with the uncertainty obtained at NIST, a clear statement should be included explaining that this has been done.

Such considerations are also relevant to the uncertainties assigned to certified devices and materials sold by NIST. However, well-justified, normal NIST practices, such as including a component of uncertainty to account for the instability of the device or material when it is known to be significant, are clearly necessary if the assigned uncertainties are to be meaningful.

8. References

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[2] ISO, *Guide to the Expression of Uncertainty in Measurement* (International Organization for Standardization, Geneva, Switzerland, 1993). This *Guide* was prepared by ISO Technical Advisory Group 4 (TAG 4), Working Group 3 (WG 3). ISO/TAG 4 has as its sponsors the BIPM, IEC, IFCC (International Federation of Clinical Chemistry), ISO, IUPAC (International Union of Pure and Applied Chemistry), IUPAP (International Union of Pure and Applied Physics), and OIML. Although the individual members of WG 3 were nominated by the BIPM, IEC, ISO, or OIML, the *Guide* is published by ISO in the name of all seven organizations. NIST staff members may obtain a single copy of the *Guide* from the NIST Calibration Program.

[3] R. Kaarls, "Rapport du Groupe de Travail sur l'Expression des Incertitudes au Comité International des Poids et Mesures," *Proc.-Verb. Com. Int. Poids et Mesures* 49, A1-A12 (1981) (in French); P. Giacomo, "News from the BIPM," *Metrologia* 17, 69-74 (1981). (Note that the final English-language version of Recommendation INC-1 (1980), published in an internal BIPM report, differs slightly from that given in the latter reference but is consistent with the authoritative French-language version given in the former reference.)

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[9] CIPM, *BIPM Proc.-Verb. Com. Int. Poids et Mesures* 54, 14, 35 (1986) (in French); P. Giacomo, "News from the BIPM," *Metrologia* 24, 45-51 (1987).

[10] C. F. Dietrich, *Uncertainty, Calibration and Probability*, second edition (Adam Hilger, Bristol, U.K., 1991), chapter 7.

Appendix A

Law of Propagation of Uncertainty

A.1 In many cases a measurand Y is not measured directly, but is determined from N other quantities $X_1, X_2, \ldots, X_N$ through a functional relation f:

$$Y = f(X_1, X_2, \ldots, X_N). \qquad \text{(A-1)}$$

Included among the quantities X_i are corrections (or correction factors) as described in subsection 5.2, as well as quantities that take into account other sources of variability, such as different observers, instruments, samples, laboratories, and times at which observations are made (e.g., different days). Thus the function f of Eq. (A-1) should express not simply a physical law but a measurement process, and in particular, it should contain all quantities that can contribute a significant uncertainty to the measurement result.

A.2 An estimate of the measurand or *output quantity* Y, denoted by y, is obtained from Eq. (A-1) using *input estimates* $x_1, x_2, \ldots, x_N$ for the values of the N *input quantities* $X_1, X_2, \ldots, X_N$. Thus the *output estimate* y, which is the result of the measurement, is given by

$$y = f(x_1, x_2, \ldots, x_N). \qquad \text{(A-2)}$$

A.3 The combined standard uncertainty of the measurement result y, designated by $u_c(y)$ and taken to represent the estimated standard deviation of the result, is the positive square root of the estimated variance $u_c^2(y)$ obtained from

$$u_c^2(y) = \sum_{i=1}^{N} \left(\frac{\partial f}{\partial x_i}\right)^2 u^2(x_i) + 2\sum_{i=1}^{N-1}\sum_{j=i+1}^{N} \frac{\partial f}{\partial x_i}\frac{\partial f}{\partial x_j} u(x_i, x_j). \qquad \text{(A-3)}$$

Equation (A-3) is based on a first-order Taylor series approximation of $Y = f(X_1, X_2, \ldots, X_N)$ and is conveniently referred to as the *law of propagation of uncertainty*. The partial derivatives $\partial f/\partial x_i$ (often referred to as *sensitivity coefficients*) are equal to $\partial f/\partial X_i$ evaluated at $X_i = x_i$; $u(x_i)$ is the standard uncertainty associated with the input estimate x_i; and $u(x_i, x_j)$ is the estimated covariance associated with x_i and x_j.

A.4 As an example of a Type A evaluation, consider an input quantity X_i whose value is estimated from n independent observations $X_{i,k}$ of X_i obtained under the same conditions of measurement. In this case the input estimate x_i is usually the sample mean

$$x_i = \bar{X}_i = \frac{1}{n}\sum_{k=1}^{n} X_{i,k}\,, \qquad \text{(A-4)}$$

and the standard uncertainty $u(x_i)$ to be associated with x_i is the estimated standard deviation of the mean

$$u(x_i) = s(\bar{X}_i) = \left(\frac{1}{n(n-1)}\sum_{k=1}^{n}(X_{i,k} - \bar{X}_i)^2\right)^{1/2}. \qquad \text{(A-5)}$$

A.5 As an example of a Type B evaluation, consider an input quantity X_i whose value is estimated from an assumed rectangular probability distribution of lower limit a_- and upper limit a_+. In this case the input estimate is usually the expectation of the distribution

$$x_i = (a_+ + a_-)/2\,, \qquad \text{(A-6)}$$

and the standard uncertainty $u(x_i)$ to be associated with x_i is the positive square root of the variance of the distribution

$$u(x_i) = a/\sqrt{3}\,, \qquad \text{(A-7)}$$

where $a = (a_+ - a_-)/2$ (see subsection 4.6).

NOTE – When x_i is obtained from an assumed distribution, the associated variance is appropriately written as $u^2(X_i)$ and the associated standard uncertainty as $u(X_i)$, but for simplicity, $u^2(x_i)$ and $u(x_i)$ are used. Similar considerations apply to the symbols $u_c^2(y)$ and $u_c(y)$.

Appendix B

Coverage Factors

B.1 This appendix summarizes a conventional procedure, given by the *Guide* [2] and Dietrich [10], intended for use in calculating a coverage factor k when the conditions of the Central Limit Theorem are met (see subsection 5.4) and (1) a value other than $k = 2$ is required for a specific application dictated by an established and documented requirement; and (2) that value of k must provide an interval having a level of confidence close to a specified value. More specifically, it is intended to yield a coverage factor k_p that produces an expanded uncertainty $U_p = k_p u_c(y)$ that defines an interval $y - U_p \leq Y \leq y + U_p$, which is commonly written as $Y = y \pm U_p$, having an approximate level of confidence p.

The four-step procedure is included in these guidelines because it is expected to find broad acceptance internationally, due in part to its computational convenience, in much the same way that $k = 2$ has become the conventional coverage factor. However, although the procedure is based on a proven approximation, it should not be interpreted as being rigourous because the approximation is extrapolated to situations where its applicability has yet to be fully investigated.

B.2 To estimate the value of such a coverage factor requires taking into account the uncertainty of $u_c(y)$, that is, how well $u_c(y)$ estimates the standard deviation associated with the measurement result. For an estimate of the standard deviation of a normal distribution, the degrees of freedom of the estimate, which depends on the size of the sample on which the estimate is based, is a measure of its uncertainty. For a combined standard uncertainty $u_c(y)$, the "effective degrees of freedom" ν_{eff} of $u_c(y)$, which is approximated by appropriately combining the degrees of freedom of its components, is a measure of its uncertainty. Hence ν_{eff} is a key factor in determining k_p. For example, if ν_{eff} is less than about 11, simply assuming that the uncertainty of $u_c(y)$ is negligible and taking $k = 2$ may be inadequate if an expanded uncertainty $U = ku_c(y)$ that defines an interval having a level of confidence close to 95 percent is required for a specific application. More specifically, according to

Table B.1 (to be discussed below), if $\nu_{eff} = 8$, $k_{95} = 2.3$ rather than 2.0. In this case, and in other similar cases where ν_{eff} of $u_c(y)$ is comparatively small and an interval having a level of confidence close to a specified level is required, it is unlikely that the uncertainty of $u_c(y)$ would be considered negligible. Instead, the small value of ν_{eff}, and thus the uncertainty of $u_c(y)$, would probably be taken into account when determining k_p.

B.3 The four-step procedure for calculating k_p is as follows:

1) Obtain y and $u_c(y)$ as indicated in Appendix A.

2) Estimate the effective degrees of freedom ν_{eff} of $u_c(y)$ from the Welch-Satterthwaite formula

$$\nu_{eff} = \frac{u_c^4(y)}{\displaystyle\sum_{i=1}^{N} \frac{c_i^4 u^4(x_i)}{\nu_i}}, \qquad \text{(B-1)}$$

where $c_i \equiv \partial f/\partial x_i$, all of the $u(x_i)$ are mutually statistically independent, ν_i is the degrees of freedom of $u(x_i)$, and

$$\nu_{eff} \le \sum_{i=1}^{N} \nu_i . \qquad \text{(B-2)}$$

The degrees of freedom of a standard uncertainty $u(x_i)$ obtained from a Type A evaluation is determined by appropriate statistical methods [7]. In the common case discussed in subsection A.4 where $x_i = \bar{X}_i$ and $u(x_i) = s(\bar{X}_i)$, the degrees of freedom of $u(x_i)$ is $\nu_i = n - 1$. If m parameters are estimated by fitting a curve to n data points by the method of least squares, the degrees of freedom of the standard uncertainty of each paramter is $n - m$.

The degrees of freedom to associate with a standard uncertainty $u(x_i)$ obtained from a Type B evaluation is more problematic. However, it is common practice to carry out such evaluations in a manner that ensures that an underestimation is avoided. For example, when lower and upper limits a_- and a_+ are set as in the case discussed in subsection A.5, they are usually chosen in such a way that the probability of the quantity in question lying outside these limits is in fact extremely small. Under the assumption that this practice is followed, the degrees of freedom of $u(x_i)$ may be taken to be $\nu_i \to \infty$.

NOTE – See the *Guide* [2] for a possible way to estimate ν_i when this assumption is not justified.

3) Obtain the t-factor $t_p(\nu_{eff})$ for the required level of confidence p from a table of values of $t_p(\nu)$ from the t-distribution, such as Table B.1 of this Appendix. If ν_{eff} is not an integer, which will usually be the case, either interpolate or truncate ν_{eff} to the next lower integer.

4) Take $k_p = t_p(\nu_{eff})$ and calculate $U_p = k_p u_c(y)$.

Table B.1 — Value of $t_p(\nu)$ from the t-distribution for degrees of freedom ν that defines an interval $-t_p(\nu)$ to $+t_p(\nu)$ that encompasses the fraction p of the distribution

Degrees of freedom ν	Fraction p in percent					
	68.27[a]	90	95	95.45[a]	99	99.73[a]
1	1.84	6.31	12.71	13.97	63.66	235.80
2	1.32	2.92	4.30	4.53	9.92	19.21
3	1.20	2.35	3.18	3.31	5.84	9.22
4	1.14	2.13	2.78	2.87	4.60	6.62
5	1.11	2.02	2.57	2.65	4.03	5.51
6	1.09	1.94	2.45	2.52	3.71	4.90
7	1.08	1.89	2.36	2.43	3.50	4.53
8	1.07	1.86	2.31	2.37	3.36	4.28
9	1.06	1.83	2.26	2.32	3.25	4.09
10	1.05	1.81	2.23	2.28	3.17	3.96
11	1.05	1.80	2.20	2.25	3.11	3.85
12	1.04	1.78	2.18	2.23	3.05	3.76
13	1.04	1.77	2.16	2.21	3.01	3.69
14	1.04	1.76	2.14	2.20	2.98	3.64
15	1.03	1.75	2.13	2.18	2.95	3.59
16	1.03	1.75	2.12	2.17	2.92	3.54
17	1.03	1.74	2.11	2.16	2.90	3.51
18	1.03	1.73	2.10	2.15	2.88	3.48
19	1.03	1.73	2.09	2.14	2.86	3.45
20	1.03	1.72	2.09	2.13	2.85	3.42
25	1.02	1.71	2.06	2.11	2.79	3.33
30	1.02	1.70	2.04	2.09	2.75	3.27
35	1.01	1.70	2.03	2.07	2.72	3.23
40	1.01	1.68	2.02	2.06	2.70	3.20
45	1.01	1.68	2.01	2.06	2.69	3.18
50	1.01	1.68	2.01	2.05	2.68	3.16
100	1.005	1.660	1.984	2.025	2.626	3.077
∞	1.000	1.645	1.960	2.000	2.576	3.000

[a]For a quantity z described by a normal distribution with expectation μ_z and standard deviation σ, the interval $\mu_z \pm k\sigma$ encompasses p = 68.27, 95.45, and 99.73 percent of the distribution for k = 1, 2, and 3, respectively.

Appendix C

NIST Technical Communications Program

APPENDIX E
STATEMENTS OF UNCERTAINTY ASSOCIATED WITH MEASUREMENT RESULTS

A measurement result is complete only when accompanied by a quantitative statement of its uncertainty. This policy requires that NIST measurement results be accompanied by such statements and that a uniform approach to expressing measurement uncertainty be followed.

1. Background

Since the early 1980s, an international consensus has been developing on a uniform approach to the expression of uncertainty in measurement. Many of NIST's sister national standards laboratories as well as a number of important metrological organizations, including the Western European Calibration Cooperation (WECC) and EUROMET, have adopted the approach recommended by the International Committee for Weights and Measures (CIPM) in 1981 [1] and reaffirmed by the CIPM in 1986 [2].

Equally important, the CIPM approach has come into use in a significant number of areas at NIST and is also becoming accepted in U.S. industry. For example, the National Conference of Standards Laboratories (NCSL) is using it to develop a Recommended Practice on measurement uncertainty for NCSL member laboratories.

The CIPM approach is based on Recommendation INC-1 (1980) of the Working Group on the Statement of Uncertainties [3]. This group was convened in 1980 by the International Bureau of Weights and Measures (BIPM) in response to a request by the CIPM. More recently, at the request of the CIPM, a joint BIPM/IEC/ISO/OIML working group developed a comprehensive reference document on the general application of the CIPM approach titled *Guide to the Expression of Uncertainty in Measurement* [4] (IEC: International Electrotechnical Commission; ISO: International Organization for Standardization; OIML: International Organization of Legal Metrology). The development of the *Guide* is providing further impetus to the worldwide adoption of the CIPM approach.

2. Policy

All NIST measurement results are to be accompanied by quantitative statements of uncertainty. To ensure that such statements are consistent with each other and with present international practice, this NIST policy adopts in substance the approach to expressing measurement uncertainty recommended by the International Committee for Weights and Measures (CIPM). The CIPM approach as adapted for use by NIST is:

1) *Standard Uncertainty*: Represent each component of uncertainty that contributes to the uncertainty of the measurement result by an estimated standard deviation u_i, termed **standard uncertainty**, equal to the positive square root of the estimated variance u_i^2.

2) *Combined Standard Uncertainty*: Determine the **combined standard uncertainty** u_c of the measurement result, taken to represent the estimated standard deviation of the result, by combining the individual standard uncertainties u_i (and covariances as appropriate) using the usual "root-sum-of-squares" method, or equivalent established and documented methods.

   Commonly, u_c is used for reporting results of determinations of fundamental constants, fundamental metrological research, and international comparisons of realizations of SI units.

3) *Expanded Uncertainty*: Determine an **expanded uncertainty** U by multiplying u_c by a **coverage factor** k: $U = ku_c$. The purpose of U is to provide an interval $y - U$ to $y + U$ about the result y within which the value of Y, the specific quantity subject to measurement and estimated by y, can be asserted to lie with a high level of confidence. Thus one can confidently assert that $y - U \leq Y \leq y + U$, which is commonly written as $Y = y \pm U$.

Use expanded uncertainty U to report the results of all NIST measurements other than those for which u_c has traditionally been employed. To be consistent with current international practice, the value of k to be used at NIST for calculating U is, by convention, $k = 2$. Values of k other than 2 are only to be used for specific applications dictated by established and documented requirements.

4) *Reporting Uncertainty*: Report U together with the coverage factor k used to obtain it, or report u_c.

When reporting a measurement result and its uncertainty, include the following information in the report itself or by referring to a published document:

- A list of all components of standard uncertainty, together with their degrees of freedom where appropriate, and the resulting value of u_c. The components should be identified according to the method used to estimate their numerical values:
  - A. those which are evaluated by statistical methods,
  - B. those which are evaluated by other means.
- A detailed description of how each component of standard uncertainty was evaluated.
- A description of how k was chosen when k is not taken equal to 2.

It is often desirable to provide a probability interpretation, such as a level of confidence, for the interval defined by U or u_c. When this is done, the basis for such a statement must be given.

Additional guidance on the use of the CIPM approach at NIST may be found in *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results* [5]. A more detailed discussion of the CIPM approach is given in the *Guide to the Expression of Uncertainty in Measurement* [4]. Classic expositions of the statistical evaluation of measurement processes are given in references [6-8].

3. Responsibilities

a. Operating Unit Directors are responsible for compliance with this policy.

b. The Statistical Engineering Division, Computing and Applied Mathematics Laboratory, is responsible for providing technical advice on statistical methods for evaluating and expressing the uncertainty of NIST measurement results.

c. NIST Editorial Review Boards are responsible for ensuring that statements of measurement uncertainty are included in NIST publications and other technical outputs under their jurisdiction which report measurement results and that such statements are in conformity with this policy.

d. The Calibrations Advisory Group is responsible for ensuring that calibration and test reports and other technical outputs under its jurisdiction are in compliance with this policy.

e. The Standard Reference Materials and Standard Reference Data programs are responsible for ensuring that technical outputs under their jurisdiction are in compliance with this policy.

f. Authors, as part of the process of preparing manuscripts and other technical outputs, are responsible for formulating measurement uncertainty statements consistent with this policy. These statements must be present in drafts submitted for NIST review and approval.

4. Exceptions

It is understood that any valid statistical method that is technically justified under the existing circumstances may be used to determine the equivalent of u_i, u_c, or U. Further, it is recognized that international, national, or contractual agreements to which NIST is a party may occasionally require deviation from this policy. In both cases, the report of uncertainty must document what was done and why.

5. References Cited

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[4] ISO, *Guide to the Expression of Uncertainty in Measurement*, prepared by ISO Technical Advisory Group 4 (TAG 4), Working Group 3 (WG 3), October 1993. ISO/TAG 4 has as its sponsors the BIPM, IEC, IFCC (International Federation of Clinical Chemistry), ISO, IUPAC (International Union of Pure and Applied Chemistry), IUPAP (International Union of Pure and Applied Physics), and OIML. Although the individual members of WG 3 were nominated by the BIPM, IEC, ISO, or OIML, the *Guide* is published by ISO in the name of all seven organizations. NIST staff members may obtain a single copy of the *Guide* from the NIST Calibration Program.

[5] B. N. Taylor and C. E. Kuyatt, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, NIST Technical Note 1297, prepared under the auspices of the NIST Ad Hoc Committee on Uncertainty Statements (U.S. Government Printing Office, Washington, DC, January 1993).

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Appendix D

Clarification and Additional Guidance

As indicated in our Preface to this second (1994) edition of TN 1297, Appendix D has been added to clarify and provide additional guidance on a number of topics. It was prepared in response to questions asked since the publication of the first (1993) edition.

D.1 Terminology

D.1.1 There are a number of terms that are commonly used in connection with the subject of measurement uncertainty, such as accuracy of measurement, reproducibility of results of measurements, and correction. One can avoid confusion by using such terms in a way that is consistent with other international documents.

Definitions of many of these terms are given in the *International Vocabulary of Basic and General Terms in Metrology* [D.1], the title of which is commonly abbreviated VIM. The VIM and the *Guide* may be viewed as companion documents inasmuch as the VIM, like the *Guide*, was developed by ISO Technical Advisory Group 4 (TAG 4), in this case by its Working Group 1 (WG 1); and the VIM, like the *Guide*, was published by ISO in the name of the seven organizations that participate in the work of TAG 4. Indeed, the *Guide* contains the VIM definitions of 24 relevant terms. For the convenience of the users of TN 1297, the definitions of eight of these terms are included here.

NOTE – In the following definitions, the use of parentheses around certain words of some terms means that the words may by omitted if this is unlikely to cause confusion. The VIM identification number for a particular term is shown in brackets after the term.

D.1.1.1 accuracy of measurement [VIM 3.5]
closeness of the agreement between the result of a measurement and the value of the measurand

NOTES

1 "Accuracy" is a qualitative concept.

2 The term precision should not be used for "accuracy."

TN 1297 Comments:

1 The phrase "a true value of the measurand" (or sometimes simply "a true value"), which is used in the VIM definition of this and other terms, has been replaced here and elsewhere with the phrase "the value of the measurand." This has been done to reflect the view of the *Guide*, which we share, that "a true value of a measurand" is simply the value of the measurand. (See subclause D.3.5 of the *Guide* for further discussion.)

2 Because "accuracy" is a qualitative concept, one should not use it quantitatively, that is, associate numbers with it; numbers should be associated with measures of uncertainty instead. Thus one may write "the standard uncertainty is 2 μΩ" but not "the accuracy is 2 μΩ."

3 To avoid confusion and the proliferation of undefined, qualitative terms, we recommend that the word "inaccuracy" not be used.

4 The VIM does not give a definition for "precision" because of the many definitions that exist for this word. For a discussion of precision, see subsection D.1.2.

D.1.1.2 repeatability (of results of measurements) [VIM 3.6]
closeness of the agreement between the results of successive measurements of the same measurand carried out under the same conditions of measurement

NOTES

1 These conditions are called repeatability conditions

2 Repeatability conditions include:

- the same measurement procedure
- the same observer
- the same measuring instrument, used under the same conditions
- the same location
- repetition over a short period of time.

3 Repeatability may be expressed quantitatively in terms of the dispersion characteristics of the results.

D.1.1.3 reproducibility (of results of measurements) [VIM 3.7]
closeness of the agreement between the results of measurements of the same measurand carried out under changed conditions of measurement

NOTES

1 A valid statement of reproducibility requires specification of the conditions changed.

2 The changed conditions may include:

- principle of measurement
- method of measurement
- observer

- measuring instrument
- reference standard
- location
- conditions of use
- time.

3 Reproducibility may be expressed quantitatively in terms of the dispersion characteristics of the results.

4 Results are here usually understood to be corrected results.

D.1.1.4 error (of measurement) [VIM 3.10]
result of a measurement minus the value of the measurand

NOTES

1 Since the value of the measurand cannot be determined, in practice a conventional value is [sometimes] used (see [VIM] 1.19 and 1.20).

2 When it is necessary to distinguish "error" from "relative error," the former is sometimes called absolute error of measurement. This should not be confused with absolute value of error, which is the modulus of the error.

TN 1297 Comments:

1 As pointed out in the *Guide*, if the result of a measurement depends on the values of quantities other than the measurand, the errors of the measured values of these quantities contribute to the error of the result of the measurement.

2 In general, the error of measurement is unknown because the value of the measurand is unknown. However, the uncertainty of the result of a measurement may be evaluated.

3 As also pointed out in the *Guide*, if a device (taken to include measurement standards, reference materials, etc.) is tested through a comparison with a known reference standard and the uncertainties associated with the standard and the comparison procedure can be assumed to be negligible relative to the required uncertainty of the test, the comparison may be viewed as determining the error of the device.

D.1.1.5 random error [VIM 3.13]
result of a measurement minus the mean that would result from an infinite number of measurements of the same measurand carried out under repeatability conditions

NOTES

1 Random error is equal to error minus systematic error.

2 Because only a finite number of measurements can be made, it is possible to determine only an estimate of random error.

TN 1297 Comment:

The concept of random error is also often applied when the conditions of measurement are changed (see subsection D.1.1.3). For example, one can conceive of obtaining measurement results from many different observers while holding all other conditions constant, and then calculating the mean of the results as well as an appropriate measure of their dispersion (e.g., the variance or standard deviation of the results).

D.1.1.6 systematic error [VIM 3.14]
mean that would result from an infinite number of measurements of the same measurand carried out under repeatability conditions minus the value of the measurand

NOTES

1 Systematic error is equal to error minus random error.

2 Like the value of the measurand, systematic error and its causes cannot be completely known.

3 For a measuring instrument, see "bias" ([VIM] 5.25).

TN 1297 Comments:

1 As pointed out in the *Guide*, the error of the result of a measurement may often be considered as arising from a number of random and systematic effects that contribute individual components of error to the error of the result.

2 Although the term bias is often used as a synonym for the term systematic error, because systematic error is defined in a broadly applicable way in the VIM while bias is defined only in connection with a measuring instrument, we recommend the use of the term systematic error.

D.1.1.7 correction [VIM 3.15]
value added algebraically to the uncorrected result of a measurement to compensate for systematic error

NOTES

1 The correction is equal to the negative of the estimated systematic error.

2 Since the systematic error cannot be known perfectly, the compensation cannot be complete.

D.1.1.8 correction factor [VIM 3.16]
numerical factor by which the uncorrected result of a measurement is multiplied to compensate for systematic error

NOTE – Since the systematic error cannot be known perfectly, the compensation cannot be complete.

D.1.2 As indicated in subsection D.1.1.1, TN 1297 comment 4, the VIM does not give a definition for the word "precision." However, ISO 3534-1 [D.2] defines precision to mean "the closeness of agreement between independent test results obtained under stipulated conditions." Further, it views the concept of precision as encompassing both repeatability and reproducibility (see subsections D.1.1.2 and D.1.1.3) since it defines repeatability as "precision under repeatability conditions," and reproducibility as "precision under reproducibility conditions." Nevertheless, precision is often taken to mean simply repeatability.

The term precision, as well as the terms accuracy, repeatability, reproducibility, variability, and uncertainty, are examples of terms that represent qualitative concepts and thus should be used with care. In particular, it is our strong recommendation that such terms not be used as synonyms or labels for quantitative estimates. For example, the statement "the precision of the measurement results, expressed as the standard deviation obtained under repeatability conditions, is 2 μΩ" is acceptable, but the statement "the precision of the measurement results is 2 μΩ" is not. (See also subsection D.1.1.1, TN 1297 comment 2.)

Although reference [D.2] states that "The measure of precision is usually expressed in terms of imprecision and computed as a standard deviation of the test results," we recommend that to avoid confusion, the word "imprecision" not be used; standard deviation and standard uncertainty are preferred, as appropriate (see subsection D.1.5).

It should also be borne in mind that the NIST policy on expressing the uncertainty of measurement results normally requires the use of the terms standard uncertainty, combined standard uncertainty, expanded uncertainty, or their "relative" forms (see subsection D.1.4), and the listing of all components of standard uncertainty. Hence the use of terms such as accuracy, precision, and bias should normally be as adjuncts to the required terms and their relationship to the required terms should be made clear. This situation is similar to the NIST policy on the use of units that are not part of the SI: the SI units must be stated first, with the units that are not part of the SI in parentheses (see subsection D.6.2).

D.1.3 The designations "A" and "B" apply to the two distinct *methods* by which uncertainty components may be *evaluated*. However, for convenience, a standard uncertainty obtained from a Type A evaluation may be called a *Type A standard uncertainty*, and a standard uncertainty obtained from a type B evaluation may be called a *Type B standard uncertainty*. This means that:

(1) "A" and "B" have nothing to do with the traditional terms "random" and "systematic";

(2) there are no "Type A errors" or "Type B errors"; and

(3) "Random uncertainty" (i.e., an uncertainty component that arises from a random effect) is not a synonym for Type A standard uncertainty; and "systematic uncertainty" (i.e., an uncertainty component that arises from a correction for a systematic error) is not a synonym for Type B standard uncertainty.

In fact, we recommend that the terms "random uncertainty" and "systematic uncertainty" be avoided because the adjectives "random" and "systematic," while appropriate modifiers for the word "error," are not appropriate modifiers for the word "uncertainty" (one can hardly imagine an uncertainty component that varies randomly or that is systematic).

D.1.4 If $u(x_i)$ is a standard uncertainty, then $u(x_i)/|x_i|$, $x_i \neq 0$, is the corresponding *relative standard uncertainty*; if $u_c(y)$ is a combined standard uncertainty, then $u_c(y)/|y|$, $y \neq 0$, is the corresponding *relative combined standard uncertainty*; and if $U = ku_c(y)$ is an expanded uncertainty, then $U/|y|$, $y \neq 0$, is the corresponding *relative expanded uncertainty*. Such relative uncertainties may be readily indicated by using a subscript "r" for the word "relative." Thus $u_r(x_i) \equiv u(x_i)/|x_i|$, $u_{c,r}(y) \equiv u_c(y)/|y|$, and $U_r \equiv U/|y|$.

D.1.5 As pointed out in subsection D.1.2, the use of the terms standard uncertainty, combined standard uncertainty, expanded uncertainty, or their equivalent "relative" forms (see subsection D.1.4), is normally required by NIST policy. Alternate terms should therefore play a subsidiary role in any NIST publication that reports the result of a measurement and its uncertainty. However, since it will take some time before the meanings of these terms become well known, they should be defined at the beginning of a paper or when first used. In the latter case, this may be done by writing, for example, "the standard uncertainty (estimated standard deviation) is $u(R) = 2$ μΩ"; or "the expanded uncertainty (coverage factor $k=2$ and thus a two-standard-deviation estimate) is $U = 4$ μΩ."

It should also be recognized that, while an estimated standard deviation that is a component of uncertainty of a measurement result is properly called a "standard uncertainty," not every estimated standard deviation is necessarily a standard uncertainty.

D.1.6 Words such as "estimated" or "limits of" should normally not be used to modify "standard uncertainty," "combined standard uncertainty," "expanded uncertainty," the "relative" forms of these terms (see subsection D.1.4), or more generally "uncertainty." The word "uncertainty," by its very nature, implies that the uncertainty of the result of a measurement is an estimate and generally does not have well-defined limits.

D.1.7 The phrase "components of uncertainty that contribute to the uncertainty of the measurement result" can have two distinct meanings. For example, if the input estimates x_i are uncorrelated, Eq. (A-3) of Appendix A may be written as

$$u_c^2 = \sum_{i=1}^{N} [c_i u(x_i)]^2 \equiv \sum_{i=1}^{N} u_i^2(y), \qquad \text{(D-1)}$$

where $c_i \equiv \partial f/\partial x_i$ and $u_i(y) \equiv |c_i| u(x_i)$.

In Eq. (D-1), both $u(x_i)$ and $u_i(y)$ can be considered components of uncertainty of the measurement result y. This is because the $u(x_i)$ are the standard uncertainties of the input estimates x_i on which the output estimate or measurement result y depends; and the $u_i(y)$ are the standard uncertainties of which the combined standard uncertainty $u_c(y)$ of the measurement result y is composed. In short, both $u(x_i)$ and $u_i(y)$ can be viewed as components of uncertainty that give rise to the combined standard uncertainty $u_c(y)$ of the measurement result y. This implies that in subsections 2.4 to 2.6, 4.4 to 4.6, and 6.6; in 1) and 2) of section 2 of Appendix C; and in section 4 of Appendix C, the symbols u_i, s_i, or u_j may be viewed as representing either $u(x_i)$ or $u_i(y)$.

When one gives the components of uncertainty of a result of a measurement, it is recommended that one also give the standard uncertainties $u(x_i)$ of the input estimates x_i, the sensitivity coefficients $c_i \equiv \partial f/\partial x_i$, and the standard uncertainties $u_i(y) = |c_i| u(x_i)$ of which the combined standard uncertainty $u_c(y)$ is composed (so-called standard uncertainty components of combined standard uncertainty).

D.1.8 The VIM gives the name "experimental standard deviation of the mean" to the quantity $s(\bar{X}_i)$ of Eq. (A-5) of Appendix A of this Technical Note, and the name "experimental standard deviation" to the quantity $s(X_{i,k}) = \sqrt{n}\, s(\bar{X}_i)$. We believe that these are convenient, descriptive terms, and therefore suggest that NIST authors consider using them.

D.2 Identification of uncertainty components

D.2.1 The NIST policy on expressing measurement uncertainty states that all components of standard uncertainty "should be identified according to the method used to estimate their numerical values: A. those which are evaluated by statistical methods, B. those which are evaluated by other means."

Such identification will usually be readily apparent in the "detailed description of how each component of standard uncertainty was evaluated" that is required by the NIST policy. However, such identification can also be given in a table which lists the components of standard uncertainty. Tables D.1 and D.2, which are based on the end-gauge

Table D.1 – Uncertainty Budget: End-Gauge Calibration

Source of uncertainty	Standard uncertainty (nm)
Calibration of standard end gauge	25 (B)
Measured difference between end gauges:	
repeated observations	5.8 (A)
random effects of comparator	3.9 (A)
systematic effects of comparator	6.7 (B)
Thermal expansion of standard end gauge	1.7 (B)
Temperature of test bed:	
mean temperature of bed	5.8 (A)
cyclic variation of temperature of room	10.2 (B)
Difference in expansion coefficients of end gauges	2.9 (B)
Difference in temperatures of end gauges	16.6 (B)
Combined standard uncertainty: $u_c(l)$ = 34 nm	

Table D.2 – Uncertainty Budget: End-Gauge Calibration

Source of uncertainty	Standard uncertainties from random effects in the current measurement process (nm)		Standard uncertainties from systematic effects in the current measurement process (nm)	
	Type A evaluation	Type B evaluation	Type A evaluation	Type B evaluation
Calibration of standard end gauge				25
Measured difference between end gauges:				
repeated observations	5.8			
random effects of comparator			3.9	
systematic effects of comparator				6.7
Thermal expansion of standard end gauge				1.7
Temperature of test bed:				
mean temperature of bed	5.8			
cyclic variation of temperature of room				10.2
Difference in expansion coefficients of end gauges				2.9
Difference in temperatures of end gauges		16.6		
Combined standard uncertainty: $u_c(l) = 34$ nm				

calibration example of the *Guide* (subclause H.1), are two examples of such tables.

D.2.2 In Table D.1, the method used to evaluate a particular standard uncertainty is shown in parentheses. In Table D.2, the method is indicated by using different columns. The latter table also shows how one can indicate whether a component arose from a random effect in the current measurement process or from a systematic effect in the current measurement process, assuming that such information is believed to be useful to the reader.

If a standard uncertainty is obtained from a source outside of the current measurement process and the nature of its individual components are unknown (which will often be the case), it may be classified as having been obtained from a Type B evaluation. If the standard uncertainty from an outside source is known to be composed of components obtained from both Type A and Type B evaluations but the magnitudes of the individual components are unknown, then one may indicate this by using (A,B) rather than (B) in a table such as D.1.

On the other hand, a standard uncertainty known to be composed of components obtained from Type A evaluations alone should be classified as a Type A standard uncertainty, while a standard uncertainty known to be composed of components obtained from Type B evaluations alone should be classified as a Type B standard uncertainty.

In this same vein, if the combined standard uncertainty $u_c(y)$ of the measurement result y is obtained from Type A standard uncertainties (and covariances) only, it too may be considered Type A, even though no direct observations were made of the measurand Y of which the measurement result y is an estimate. Similarly, if a combined standard uncertainty is obtained from Type B standard uncertainties (and covariances) only, it too may be considered Type B.

D.3 Equation (A-2)

D.3.1 In the most general sense, Eq. (A-2) of Appendix A of this Technical Note,

$$y = f(x_1, x_2, \ldots, x_N) \,, \tag{A-2}$$

is a symbolic representation of the procedure (or algorithm) used to obtain the output estimate y, which is the result of the measurement, from the individual input estimates x_i. For example, some of the x_i may themselves depend on additional input estimates:

$$x_1 = g_1(w_1, w_2, \ldots, w_K)$$
$$x_2 = g_2(z_1, z_2, \ldots, z_L)$$
etc.

Or the output estimate y may be expressible simply as

$$y = x + C_1 + C_2 + \ldots + C_M \,,$$

where the C_i are corrections, for example, for the operator, for the ambient temperature, for the laboratory, etc. Some or all of the C_i may be estimated to be near zero based on the available information, but they can still have standard uncertainties that are large enough to contribute significantly to the combined standard uncertainty of the measurement result and which therefore must be evaluated.

NOTE – In some situations, a correction for a particular effect and its standard uncertainty are estimated to be negligible relative to the required combined standard uncertainty of the measurement result, and for added confidence, an experimental test is carried out that confirms the estimate but the standard uncertainty of the test result is not negligible. In such cases, if other evidence indicates that the estimate is in fact reliable, the standard uncertainty of the test result need not be included in the uncertainty budget and both the correction and its standard uncertainty can be taken as negligible.

D.4 Measurand defined by the measurement method; characterization of test methods; simple calibration

D.4.1 The approach to evaluating and expressing the uncertainty of a measurement result on which the NIST policy and this Technical Note are based is applicable to evaluating and expressing the uncertainty of the estimated value of a measurand that is *defined* by a standard method of measurement. In this case, the uncertainty depends not only on the repeatability and reproducibility of the measurement results (see subsections D.1.1.2 and D.1.1.3), but also on how well one believes the standard measurement method has been implemented. (See example H.6 of the *Guide*.)

When reporting the estimated value and uncertainty of such a measurand, one should always make clear that the measurand is defined by a particular method of measurement and indicate what that method is. One should also give the measurand a name which indicates that it is defined by a measurement method, for example, by adding a modifier such as "conventional." (See also subsection D.6.1)

D.4.2 There are national as well as international standards that discuss the characterization of test methods by interlaboratory comparisons. Execution of test methods according to these standards, both in the characterization stage and in subsequent measurement programs, often calls for the expression of uncertainties in terms of defined measures of repeatability and reproducibility. When NIST authors participate in such characterization or measurement programs, NIST policy allows for the results to be expressed as required by the relevant standards (see Appendix C, section 4). However, when NIST authors document work according to such standards, they should consider making the resulting publication understandable to a broad audience. This might be achieved in part by giving definitions of the terms used, perhaps in a footnote. If possible, NIST authors should relate these terms to those of this Technical Note and of the *Guide*.

If a test method is employed at NIST to obtain measurement results for reasons other than those described above, it is expected that the uncertainties of these measurement results will be evaluated and reported according to section 2 of the NIST policy (see Appendix C). This would be the case, for example, if measurement results from a characterized test method are compared to those from a new method of measurement which has not been characterized by interlaboratory comparisons.

D.4.3 When an unknown standard is calibrated in terms of a known reference standard at lower levels of the measurement hierarchy, the uncertainty of the result of calibration may have as few as two components: a single Type A standard uncertainty evaluated from the pooled experimental standard deviation that characterizes the calibration process; and a single Type B (or possibly

Type A) standard uncertainty obtained from the calibration certificate of the known reference standard.

NOTE – The possibility of unsuspected systematic effects in the calibration process used to calibrate the unknown standard should, however, not be overlooked.

D.5 t_p and the quantile $t_{1-\alpha}$

D.5.1 As pointed out in the *Guide*, the t-distribution is often tabulated in quantiles. That is, values of the quantile $t_{1-\alpha}$ are given, where $1 - \alpha$ denotes the cumulative probability and the relation

$$1 - \alpha = \int_{-\infty}^{t_{1-\alpha}} f(t, \nu)\,dt$$

defines the quantile, where f is the probability density function of t. Thus t_p of this Technical Note and of the *Guide* and $t_{1-\alpha}$ are related by $p = 1 - 2\alpha$. For example, the value of the quantile $t_{0.975}$, for which $1 - \alpha = 0.975$ and $\alpha = 0.025$, is the same as $t_p(\nu)$ for $p = 0.95$. It should be noted, however, that in reference [D.2] the symbol p is used for the cumulative probability $1 - \alpha$, and the resulting $t_p(\nu)$ is called the "quantile of order p of the t variable with ν degrees of freedom." Clearly, the values of $t_p(\nu)$ defined in this way differ from the values of $t_p(\nu)$ defined as in this Technical Note and in the *Guide*, and given in Table B.1 (which is of the same form as that given in reference [10]). Thus, one must use tables of tabulated values of $t_p(\nu)$ with some care.

D.6 Uncertainty and units of the SI; proper use of the SI and quantity and unit symbols

D.6.1 As pointed out in the *Guide*, the result of a measurement is sometimes expressed in terms of the adopted value of a measurement standard or in terms of a conventional reference value rather than in terms of the relevant unit of the SI. (This is an example of a situation in which all significant components of uncertainty are not taken into account.) In such cases the magnitude of the uncertainty ascribable to the measurement result may be significantly smaller than when that result is expressed in the relevant SI unit. This practice is not disallowed by the NIST policy, but it should always be made clear when the practice is being followed. In addition, one should always give some indication of the values of the components of uncertainty not taken into account. The following example is taken from the *Guide*. (See also subsection D.4.1.)

EXAMPLE – A high-quality Zener voltage standard is calibrated by comparison with a Josephson effect voltage reference based on the conventional value of the Josephson constant recommended for international use by the CIPM. The relative combined standard uncertainty $u_c(V_S)/V_S$ of the calibrated potential difference V_S of the Zener standard is 2×10^{-8} when V_S is reported in terms of the conventional value, but $u_c(V_S)/V_S$ is 4×10^{-7} when V_S is reported in terms of the SI unit of potential difference, the volt (V), because of the additional uncertainty associated with the SI value of the Josephson constant.

D.6.2 NIST Special Publication 811, 1995 Edition [D.3], gives guidance on the use of the SI and on the rules and style conventions regarding quantity and unit symbols. In particular, it elaborates upon the NIST policy regarding the SI and explains why abbreviations such as ppm and ppb and terms such as normality and molarity should not be used. NIST authors should consult NIST SP 811 if they have any questions concerning the proper way to express the values of quantities and their uncertainties.

D.7 References

[D.1] ISO, *International Vocabulary of Basic and General Terms in Metrology*, second edition (International Organization for Standardization, Geneva, Switzerland, 1993). This document (abbreviated VIM) was prepared by ISO Technical Advisory Group 4 (TAG 4), Working Group 1 (WG 1). ISO/TAG 4 has as its sponsors the BIPM, IEC, IFCC (International Federation of Clinical Chemistry), ISO, IUPAC (International Union of Pure and Applied Chemistry), IUPAP (International Union of Pure and Applied Physics), and OIML. The individual members of WG 1 were nominated by BIPM, IEC, IFCC, ISO, IUPAC IUPAP, or OIML, and the document is published by ISO in the name of all seven organizations. NIST staff members may obtain a single copy of the VIM from the NIST Calibration Program.

[D.2] ISO 3534-1:1993, *Statistics—Vocabulary and symbols —Part 1: Probability and general statistical terms* (International Organization for Standardization, Geneva, Switzerland, 1993).

[D.3] B. N. Taylor, *Guide for the Use of the International System of Units (SI)*, NIST Special Publication 811, 1995 Edition (U.S. Government Printing Office, Washington, DC, April 1995).

Traceability - NIST Policy and Supplementary Materials

NIST has developed an organizational policy on traceability and a set of related supplementary materials, which includes answers to questions frequently asked by customers of NIST measurement services. The policy and supplementary materials are intended to serve as a resource for NIST customers.

NIST is responsible for developing, maintaining and disseminating national standards – realizations of the SI - for the basic measurement quantities, and for many derived measurement quantities. NIST is also responsible for assessing the measurement uncertainties associated with the values assigned to these measurement standards. As such, the concept of measurement traceability is central to NIST's mission. NIST's customers frequently ask questions about traceability and about NIST's role in traceability. It is not always obvious what NIST's role is in helping other organizations establish traceability of their measurement results to standards developed and maintained by NIST.

The primary purpose of the NIST Policy on Traceability is to state the NIST role with respect to traceability. The Policy presents the definition of measurement traceability used by NIST, and clarifies the roles of NIST and others in achieving traceability of measurement results for measurements both internal and external to NIST.

The NIST Policy on Traceability also addresses the role of NIST in providing its customers with the tools they need (a) to assist them in establishing traceability of their measurement results, and (b) to assess the claims of traceability made by others. This is achieved directly through the provision of NIST measurement-related products and services, through collaboration with relevant organizations, through development and dissemination of technical information on traceability, and through conducting coordinated outreach programs.

The Policy, along with Supplementary Materials and NIST publications, supports NIST in articulating a consistent message regarding its role in traceability, and provides a basis for NIST to focus its efforts on needed communication and training areas. Related NIST outreach programs, referenced in the Policy, also represent and articulate the NIST role in traceability. The Supplementary Materials are intended to assist NIST staff in their understanding, interpretation, and implementation of the Policy, and to serve as a resource for NIST customers.

The NIST Policy on Traceability is contained in the NIST Administrative Manual, Subchapter 5.16.

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NIST HOME

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Website Technical Contact: TS Webmaster

Web page created: April 16, 2001
modified: December 3, 2001

NIST Policy on Traceability

NIST has developed an organizational policy on traceability and a set of related supplementary materials, which includes answers to questions frequently asked by customers of NIST measurement services. The policy and supplementary materials are intended to serve as a resource for NIST customers.

Introduction

The mission of NIST is to develop and promote measurement, standards, and technology to enhance productivity, facilitate trade, and improve the quality of life. To help meet the measurement and standards needs of U.S. industry and the nation, NIST provides calibrations, standard reference materials, standard reference data, test methods, proficiency evaluation materials, measurement quality assurance programs, and laboratory accreditation services that assist a customer in establishing traceability of results of measurements or values of standards.

Traceability requires the establishment of an unbroken chain of comparisons to stated references. NIST assures the traceability of results of measurements or values of standards that NIST itself provides, either directly or through an official NIST program or collaboration. Other organizations are responsible for establishing the traceability of their own results or values to those of NIST or other stated references. NIST has adopted this policy statement to document the NIST role with respect to traceability.

Statement of Policy

To support the conduct of its mission and to ensure that the use of its name, products, and services is consistent with its authority and responsibility, NIST:

1. Adopts for its own use and recommends for use by others the definition of traceability provided in the most recent version of the *International Vocabulary of Basic and General Terms in Metrology*: "property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties." (International Vocabulary of Basic and General Terms in Metrology (VIM), BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML, 2nd ed., 1993, definition 6.10)
2. Establishes traceability of the results of its own measurements and values of its own standards and of results and values provided to customers in NIST calibration and

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measurement certificates, operating in accordance with the *NIST System for Assuring Quality in the Results of Measurements Delivered to Customers in Calibration and Measurement Certificates* see http://www.nist.gov/nistsystem/

3. Asserts that providing support for a claim of traceability of the result of a measurement or value of a standard is the responsibility of the **provider** of that result or value, whether that provider is NIST or another organization; and that assessing the validity of such a claim is the responsibility of the user of that result or value.
4. Communicates, especially where claims expressing or implying the contrary are made, that NIST does not define, specify, assure, or certify traceability of the results of measurements or values of standards except those that NIST itself provides, either directly or through an official NIST program or collaboration. (See also NIST Administrative Manual, Subchapter 5.03, *NIST Policy on Use of its Name in Advertising* at http://ts.nist.gov/traceability/503.htm)
5. Collaborates on development of standard definitions, interpretations, and recommended practices with organizations that have authority and responsibility for variously defining, specifying, assuring, or certifying traceability.
6. Develops and disseminates technical information on traceability and conducts coordinated outreach programs on issues of traceability and related requirements.
7. Assigns responsibility for oversight of implementation of the NIST policy on traceability to the NIST Measurement Services Advisory Group.

Return to the NIST Policy on Traceability - Introduction

Please send comments or questions to traceability@nist.gov

Supplementary Materials

NIST has developed an organizational policy on traceability and a set of related supplementary materials, which includes answers to questions frequently asked by customers of NIST measurement services. The policy and supplementary materials are intended to serve as a resource for NIST customers.

I. Definitions

II. Frequently Asked Questions

A. Questions about Traceability in General

1. What is traceability?
2. Is it correct to say that measurements or standards are traceable?
3. Is it correct to say that an organization is traceable?
4. Who is responsible for supporting claims of traceability?
5. What do I need to do to support a claim of traceability?
6. Who is responsible for assessing the validity of claims of traceability?
7. What should I look for in a valid claim of traceability?

B. Questions about Establishing Traceability

1. What is involved in establishing traceability?
2. Who is responsible for establishing the traceability of measurement results?
3. Does the comparison of measurement results or values with stated references need to be reexamined periodically? What are the criteria for judging if the comparison is successful?
4. Is a NIST Test Report Number sufficient evidence of traceability?
5. To establish the traceability of a measurement result for a particular measurand, is it also necessary to establish the traceability of all other values of measured quantities associated with the measurand, especially those that might contribute in a relatively minor way?

C. Questions about NIST and NIST's Role in Traceability

1. What is NIST?
2. What is NIST's role in traceability?
3. What is meant by the phrase "traceable to NIST"?
4. I want my measurement results to be traceable to NIST. What do I have to do?
5. How does NIST establish the traceability of its own measurement results?

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6. How does NIST support its own claims of traceability?
7. Does NIST certify the traceability of its own measurement results?
8. Does NIST certify the traceability of measurement results other than its own?
9. Given that NIST operates the National Voluntary Laboratory Accreditation Program (NVLAP), does this mean that NIST stands behind claims of traceability made by NVLAP-accredited labs?

D. Questions about NIST Products and Services

1. Does NIST have publications that explain what traceability is and how to achieve it?
2. What products and services does NIST provide in support of customers seeking to establish traceability?
3. If I have an instrument or artifact calibrated at NIST, does that make my measurement results traceable to NIST?
4. If I purchase an SRM, does that make my measurement results traceable to NIST?
5. If I purchase an NTRM, does that make my measurement results traceable to NIST?
6. NIST data are often used in claims of traceability to NIST. Under what conditions can one consider NIST data to be "stated references"?
7. Can an organization claim traceability to NIST by having individual instrument components calibrated at NIST? If so, is that the same as sending the entire instrument to NIST for calibration?
8. How should a customer claim traceability to NIST if NIST needs to use two or more of its own standards to calibrate the customer instrument, standard, or artifact?
9. Can a customer claim traceability to NIST for something that NIST cannot calibrate directly?

E. Questions about MRAs and Traceability

1. What is the CIPM MRA and what does it have to do with traceability?
2. If a laboratory establishes traceability of its measurement results to standards maintained by a National Measurement Institute (NMI) that is a signatory to the CIPM MRA, does that mean that that laboratory's measurement results are traceable to standards maintained by other signatory NMIs?
3. What are laboratory accreditation MRAs and what do they have to do with traceability?
4. Because NIST's National Voluntary Laboratory Accreditation Program (NVLAP) is a signatory to multiple MRAs with other accreditation bodies, does that mean NIST stands behind claims of traceability made by any laboratory accredited by any other MRA signatory?

III. Examples of NIST Programs in Traceability

A. Traceability for Personnel Radiation Dosimetry

B. Traceability for Radiopharmaceuticals

C. Traceability of Calibration Sources for Radioanalytical Instruments

D. Traceability of Commercially Produced Gas Mixture Standards

I. Definitions of Key Terms in Statement of Policy

results of measurement - According to the VIM: the value attributed to a measurand, obtained by measurement, where the measurand is the particular quantity subject to measurement and the value of the quantity is the magnitude of the particular quantity, generally expressed as a unit of measurement multiplied by a number.

value of a standard - According to the VIM: the value attributed to a material measure, measuring instrument, or measuring system intended to define, realize, conserve, or reproduce a unit or one or more values of a quantity to serve as a reference.

unbroken chain of comparisons - Here taken to mean the complete, explicitly described, and documented series of comparisons that successively link the value and uncertainty of a result of measurement with the values and uncertainties of each of the intermediate reference standards and the highest reference standard to which traceability for the result of measurement is claimed.

stated reference - Here taken to mean "stated reference standard", where: (1) stated here means explicitly set forth in supporting documentation, and (2) a reference standard, which, according to the VIM, is a standard, generally having the highest metrological quality available at a given location or in a given organization, from which measurements there are derived.

national standard - Here taken to mean "national measurement standard", which, according to the VIM, is a standard recognized by a national decision to serve in a country as the basis for assigning values to other standards of the quantity concerned.

international standard - Here taken to mean "international measurement standard", which, according to the VIM, is a standard recognized by an international agreement to serve internationally as the basis for assigning values to other standards of the quantity concerned.

stated uncertainties - Here meaning uncertainty of measurement that: (1) fulfills the VIM definition as the parameter, associated with the result of a measurement, that characterizes the dispersion of values that could reasonably be attributed to the measurand; (2) is evaluated and expressed according to the general rules given in the ISO Guide to the

Expression of Uncertainty in Measurement (or other sound and accepted method); and (3) is explicitly set forth in supporting documentation.

provider of result or value - That is, the provider of the result of a measurement or the value of a standard, here meaning the individual or organization that supplies for use the result of measurement or value of standard for which traceability is being asserted.

user of result or value - That is, the user of the result of a measurement or a value of a standard, here meaning the individual or organization that receives for use the result of measurement or value of standard for which traceability is being asserted.

organizations that have authority and responsibility for variously defining, specifying, assuring, or certifying traceability - Here meaning any regulatory agency, standards developing organization, accreditation body, trade association or the like, which, by law or mutual agreement, is assigned or takes on authority and responsibility for some aspect of defining, specifying, assuring, or certifying traceability.

defining traceability - Here meaning to authoritatively state or set forth the (operational) meaning of the term "traceability."

specifying traceability - Here meaning to assert a requirement for traceability in a given situation.

assuring traceability - Here meaning to provide support for the claim of traceability of the result of a given measurement or value of a standard.

certifying traceability - Here meaning to formally attest that traceability exists in a given situation.

official NIST program or collaboration - Here meaning a NIST program or collaboration, officially approved by NIST management, in which NIST formally assures or certifies traceability of the results of measurements or values of standards other than those that NIST itself provides.

Contents

II. Frequently Asked Questions

A. Questions about Traceability in General

1. What is traceability?

The definition of traceability that has achieved global acceptance in the metrology community is contained in the International Vocabulary of Basic and General Terms in Metrology (VIM; 1993):

"...the property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons, all having stated uncertainties."

It is important to note that traceability is the property of the result of a measurement, not of an instrument or calibration report or laboratory. It is not achieved by following any one particular procedure or using special equipment. Merely having an instrument calibrated, even by NIST, is not enough to make the measurement result obtained from that instrument traceable to realizations of the appropriate SI unit or other stated references. The measurement system by which values are transferred must be clearly understood and under control.

Contents

2. Is it correct to say that measurements or standards are traceable?

Only measurement results and values of standards are traceable.

Contents

3. Is it correct to say that an organization is traceable?

Organizations cannot be traceable. Only measurement results and values of standards can be traceable.

Contents

4. Who is responsible for supporting claims of traceability?

The provider of the result of a measurement or value of a standard is responsible for supporting its claim of the traceability of that result or value. This is the case whether that provider is NIST or another organization.

Contents

5. What do I need to do to support a claim of traceability?

To support a claim, the provider of a measurement result or value of a standard must document the measurement process or system used to establish the claim and provide a description of the chain of comparisons that were used to establish a connection to a particular stated reference. There are several common elements to all valid statements or claims of traceability:

- a clearly defined particular quantity that has been measured
- a complete description of the measurement system or working standard used to perform the measurement
- a stated measurement result or value, with a documented uncertainty
- a complete specification of the stated reference at the time the measurement system or worki standard was compared to it
- an 'internal measurement assurance' program for establishing the status of the measurement system or working standard at all times pertinent to the claim of traceability
- an 'internal measurement assurance' program for establishing the status of the stated referen the time that the measurement system or working standard was compared to it

An internal measurement assurance program may be quite simple or very complex, the level or rigor to be determined depending on the level of uncertainty at issue and what is needed to demonstrate its credibility. Users of a measurement result are responsible for determining what is adequate to meet their needs.

For information and guidance on expressing measurement uncertainty, see http://physics.nist.gov/cuu/.

{See checklist for supporting a claim of traceability through calibration for additional guidance}

Contents

6. Who is responsible for assessing the validity of claims of traceability?

The user of the result of a measurement or value of a standard is responsible for assessing the validity of a claim of traceability. However, as discussed in Question 4 above, the provider is responsible for providing the necessary information that the user assesses.

Contents

7. What should I look for in a valid claim of traceability?

See Question 5 above, which provides information on what the provider of a measurement result or value of a standard should do to support a claim of traceability. As a user, you should look for these elements. {Also see checklist for supporting a claim of traceability through calibration}

Contents

B. Questions about Establishing Traceability

1. What is involved in establishing traceability?

Per the VIM definition, traceability is established through "an unbroken chain of comparisons, all having stated uncertainties." In practical terms, this means having in place, for each link in the chain:

- a clearly defined particular quantity that has been measured
- a complete description of the measurement system or working standard used to perform the measurement
- a stated measurement result or value, with a documented uncertainty
- a complete specification of the stated reference at the time the measurement system or worki standard was compared to it
- an 'internal measurement assurance' program for establishing the status of the measurement system or working standard at all times pertinent to the claim of traceability
- an 'internal measurement assurance' program for establishing the status of the stated referen the time that the measurement system or working standard was compared to it.

An internal measurement assurance program may be quite simple or very complex, the level or rigor to be determined depending on the level of uncertainty at issue and what is needed to demonstrate its credibility. Users of a measurement result are responsible for determining what is adequate to meet their needs.

For information and guidance on expressing measurement uncertainty, see http://physics.nist.gov/cuu/.

Contents

2. Who is responsible for establishing the traceability of measurement results?

The provider of the result of a measurement is responsible for establishing the traceability of this result. This is the case whether that provider is NIST or another organization.

Contents

3. Does the comparison of measurement results or values with stated references need to be reexamined periodically? What are the criteria for judging if the comparison is successful?

Yes, the comparison does need to be reexamined periodically, and the criteria for judging success are dependent on many things. To be considered are: the measurement requirements, the needs of the client, the dependability of the equipment and standards, the environmental effects, etc. For more details, see Reference 1.

Contents

4. Is a NIST Test Report Number sufficient evidence of traceability?

Test report numbers issued by NIST are used solely for administrative purposes. Although they often uniquely identify documents that bear evidence of traceability, test report numbers themselves do not address the issues listed in II.B.1 above, and should not be considered as the sole evidence of traceability.

Contents

5. To establish the traceability of a measurement result for a particular measurand, is it also necessary to establish the traceability of all other values of measured quantities associated with the measurand, especially those that might contribute in a relatively minor way? For example, when making a dimensional measurement, do the measurements of barometric pressure, humidity, and temperature for a dimensional measurement need to be traceable to the International System of Units (SI)?

As a general principle, the definition of traceability in the VIM suggests that it is necessary to establish the traceability of all associated measurement quantities upon which the measurement result depends. A measurement result depends upon an associated measurement quantity, such as a dimensional measurement result depends upon barometric pressure, humidity, and temperature, if the value of, and/or the variation in that quantity contributes significantly to the value or stated uncertainty of the measurement result.

As a practical matter, the contribution of a measurement quantity to a measurement result is significant if a change in the value or uncertainty of the measurement quantity corresponds to a change in the significant figures of the stated value or uncertainty of the measurement result. When this is the case, traceability for the measurement of the associated measurement quantity should be established. The required levels of uncertainty that must be achieved for these associated measurement quantities may be relatively large, depending on the degree to which the measurement quantity actually affects the value or the stated uncertainty of the measurement result.

Contents

C. Questions about NIST and NIST's Role in Traceability

1. What is NIST?

NIST (http://www.nist.gov/) is an agency of the Department of Commerce. Its role as the National Measurement Institute (NMI) for the United States was established by Congress in 1901. As such, NIST has the responsibility "to develop, maintain and retain custody of the national standards of measurement, and to provide the means and methods for making measurements consistent with those standards; and to assure the compatibility of United States national measurement standards with those of other nations." [15 U.S.C. 271] The job of NIST is twofold: to ensure U.S. national standards are accurate realizations of the SI units and to transfer the values of those standards to the U.S. measurement system through calibrations and other types of measurement services. Over 800 companies a year take advantage of the opportunity to tie their internal measurement standards to NIST standards and hence, to the SI units. Those companies, in turn, use their standards to provide measurement services to their customers, to meet regulatory requirements, and to provide quality assurance in their manufacturing processes. NIST also supports laboratories that provide calibrations through its National Voluntary Laboratory Accreditation Program (NVLAP). (see also Question 2, next section, for information on NIST products and services)

Contents

2. What is NIST's role in traceability?

NIST has various roles in traceability:

- First, to provide practical access to the seven base units of the International System of Measurements (SI), including mass, length, and time, by realizing and disseminating those u through measurement services;
- second, to provide access to U.S. national standards of various other measurement quantities economic importance to the United States; and
- last, to collaborate on development of standard definitions, interpretations, and recommende practices with organizations that have authority and responsibility for variously defining, specifying, assuring, or certifying traceability.

Contents

3. What is meant by the phrase "traceable to NIST"?

According to the internationally recognized VIM definition, traceability is a property of the result of a measurement or the value of a standard by which that result or value is related to standards, not to institutions. Accordingly, the phrase "traceable to NIST", in its most proper sense, is shorthand for "results of measurements that are traceable to reference standards developed and maintained by NIST".

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4. I want my measurement results to be traceable to NIST. What do I have to do?

To achieve traceability of measurement results to standards maintained by NIST, you need to reference your measurement results through an unbroken chain of comparisons, including determining the uncertainties at each step, to NIST standards as the stated references. These stated references may be, for example, standards developed and maintained by NIST, broadcast signals controlled or monitored by NIST (such as standard time and frequency signals), NIST Standard Reference Materials, or NIST-Traceable Reference Materials. The chain of comparisons may be short, if the user has instruments or artifacts calibrated by NIST or acquires standards from NIST and references measurement results to those. It may be longer, if the user references other comparisons in a chain of comparisons back to stated references developed and maintained by NIST. Also see Question 5 above and checklist for additional guidance.

Contents

5. How does NIST establish the traceability of its own measurement results?

In general, NIST establishes the traceability of its own measurement results by following the prescription of the VIM definition of traceability, that is, through an unbroken chain of comparisons, including determining the uncertainties at each step, to stated references. In the case of the SI units, for six of the seven base units the ultimate stated reference is a CIPM-established definition of the units, including associated procedures; for one SI unit, mass, the stated reference is the international prototype kilogram. The same process also applies in the case of derived units, which are formed as products of powers of the base units according to the algebraic relations linking the quantities concerned. For other measurement quantities, the stated reference may be a national standard defined de facto by a conventionally stated method.

Contents

6. How does NIST support its own claims of traceability?

NIST documents the process by which it establishes traceability of its own measurement results as part of the NIST Quality System for Measurement Services. In accordance with this system, NIST maintains current technical descriptions of (a) the measurement facility, system, or methods; (b) the procedures for conduct of the measurement(s); (c) the analysis of uncertainty of the measurement results; and (d) the procedures for statistical control of the measurement process. This documentation includes a description of how traceability is/was achieved.

Contents

7. Does NIST certify the traceability of its own measurement results?

According to the NIST policy on traceability, NIST establishes the traceability of the results of its own measurements and values of its own standards and of results and values provided to customers in NIST calibration and measurement certificates and, if not always explicitly then always by clear implication, certifies that traceability. Although the measurement results in a calibration or measurement certificate can be considered to be 'certified' by NIST to be traceable to NIST reference standards at the time the measurements were performed, NIST cannot 'certify' that those measurement results are valid after an instrument or artifact or reference material has left NIST. The customer must have an appropriate internal measurement assurance program in place to assure the continued validity of those measurement results. See Reference 1.

Contents

8. Does NIST certify the traceability of measurement results other than its own?

NIST only certifies the traceability of measurement results that NIST itself provides, either directly or through an official NIST program or collaboration. Some examples of such official NIST programs or collaborations are described in Section III, Examples of NIST Programs in Traceability. NIST cannot be responsible for claims of traceability made by others since the process of demonstrating traceability requires that most of the steps be taken at the site of whoever is claiming traceability. NIST has no control over this process and no direct involvement in the day-to-day activities at the site. {See checklist for supporting a claim of traceability through calibration for an illustration of activities to be performed at a customer facility, as opposed to activities performed at a reference laboratory}

Contents

9. Given that NIST operates the National Voluntary Laboratory Accreditation Program (NVLAP), does this mean that NIST stands behind claims of traceability made by NVLAP-accredited labs?

No. More specifically, laboratory accreditation, whether conducted by NIST/NVLAP or any other recognized accreditation body, is a finding of a laboratory's competence and capability to provide scientifically sound and appropriate measurement services within their scope of accreditation. Embedded in the process is an evaluation of the lab's ability to achieve and maintain traceability for the accredited services. Accreditation to ISO/IEC Guide 25, now replaced with international standard ISO/IEC 17025: *General requirements for the competence of testing and calibration laboratories*, determines that a laboratory has all of the necessary facilities, equipment, standards, procedures, uncertainty analyses, personnel, etc., which make it capable of providing traceable measurement results. Laboratory accreditation does not speak to the specifics of any individual measurement result but to the overall capability of a lab to provide the service. NIST experts often participate in the accreditation process, but again, the end result is a finding of competence and capability only.

Contents

D. Questions about NIST Products/Services

1. Does NIST have publications that explain what traceability is and how to achieve it?

Yes, NIST has a variety of publications. See references list in Section V.

Contents

2. What products and services does NIST provide in support of customers seeking to establish traceability?

NIST provides a range of products and services in support of customers seeking to establish traceability of their measurement results. These include instrument calibrations, Standard Reference Materials (SRMs), and Standard Reference Data (SRD). NIST also provides measurement services to State and local governments responsible for marketplace transactions that involve measurements (Weights and Measures). NIST's Calibration Services, Standard Reference Materials , and the Weights and Measures Program make up the largest integrated national measurement transfer system in the world. The Standard Reference Data Program augments this system by providing scientists, engineers and the general public with access to critically evaluated data necessary to perform state-of-the-art research and development. Through these four programs, NIST disseminates expert metrology guidance and the measurement products and services developed in the NIST Laboratories to the industrial and scientific communities, federal agencies and state and local governments. More information may be obtained at http://ts.nist.gov.

Calibration laboratories and testing facilities may be accredited by NIST under the National Voluntary Laboratory Accreditation Program (NVLAP). The basic procedures and general accreditation requirements of NVLAP are described in NIST Handbook 150 (National Voluntary Laboratory Accreditation Program: Procedures and General Requirements, V. R. White, D. F. Alderman and C. D. Faison, Editors, July 2001). A participating laboratory may voluntarily take steps to improve or assess its measurement process.

NIST Laboratories also provide a range of training courses and workshops on measurement practices. Topics covered include precision thermometry, temperature measurement by radiation thermometry, laser measurements, gage block calibration, time and frequency fundamentals, dimensional metrology, pressure, etc.

For information and guidance on expressing measurement uncertainty, see http://physics.nist.gov/cuu/.

Contents

3. If I have an instrument or artifact calibrated at NIST, does that make my measurement results traceable to NIST?

Merely having an instrument or artifact calibrated at NIST is not enough to make the measurement result traceable to reference standards developed and maintained by NIST. To establish traceability to such reference standards, there must be an unbroken chain of comparisons and each provided measurement must be accompanied by a statement of uncertainty. The measurement system by which values are transferred must be clearly understood and under control. The dates and details of each link in the chain must also be provided.

Contents

4. If I purchase an SRM, does that make my measurement results traceable to NIST?

The purchase of an SRM does not automatically make the customer's measurement results traceable to reference standards developed and maintained by NIST. NIST SRMs serve as one mechanism for achieving measurement compatibility based on accuracy, and are intended to be used as part of a measurement system or program. The guiding principle in issuing an SRM is that it is used for measurement quality assessment. A claim of traceability to reference standards developed and maintained by NIST can be asserted by proper use of appropriate SRMs and reference to the certified values and uncertainties provided by a NIST Certificate of Analysis. This Certificate contains a statement of the intended use of the SRM (NOTE: NIST cannot foresee all the uses for a specific SRM and recognizes that defensible assertions can be made for alternative use). In general, the Certificate also contains a disclaimer for improper handling of a material. It is up to the user to document appropriate storage and preservation of a material. An SRM certificate also contains an expiration date. It is inappropriate to use an expired material to establish a traceability claim. Finally, it is up to the user to demonstrate that the Certificate of Analysis in their possession is valid and up-to-date.

Contents

5. If I purchase an NTRM, does that make my measurement results traceable to NIST?

As with SRMs, the purchase of an NTRM does not automatically make the customer's measurement results traceable to reference standards developed and maintained by NIST. However, NTRMs can be used to make a claim of traceability to NIST in the same manner as SRMs, with reference to the certified values and uncertainties on an NTRM Certificate of Analysis.

Contents

6. NIST data are often used in claims of traceability to NIST. Under what conditions can one consider NIST data to be "stated references"?

NIST provides a number of data services that are critical to the measurement infrastructure of the United States and the world. These services include:

- Standard Reference Data, that is, data that have been evaluated for validity by knowledgeabl experts in the particular field with stated uncertainties.
- Values of physical constants measured by NIST researchers and published in the peer-reviev literature with stated uncertainties
- Measurements of properties that result from various NIST research programs, which may or not have complete expressed uncertainty.
- Collections of unevaluated data compiled by NIST scientists for various R&D purposes

Great effort is made to describe clearly the type of data in NIST electronic and printed data collections. Usually, data from NIST are accompanied by uncertainties that have been estimated and propagated according to the Guide to the Expression of Uncertainty in Measurement (GUM). When data are evaluated, the scientific basis used in evaluating these data is well documented and the data labeled as NIST Standard Reference Data.

The use of these data as "stated references" depends on the type of collection (Standard Reference Data, values of physical constants, etc.), the date of the most recent evaluation or compilation, and the direct relevance of the data to the physical measurement for which traceability is needed. In particular, if the data are not part of a NIST compilation of evaluated data, then care should be taken to assess the expressed uncertainty, and the literature checked for additional values for comparison.

Contents

7. Can an organization claim traceability to NIST by having individual instrument components calibrated at NIST? If so, is that the same as sending the entire instrument to NIST for calibration?

If the claim of traceability to reference standards developed and maintained by NIST is supported by an appropriate measurement assurance process and uncertainty analysis, the claim may be valid. The measurement process and uncertainty analysis must show how the basic component measurements are combined and translated into a complete calibration for the instrument in question. Is it the same as sending the complete instrument in? Possibly, but only when the organization combines the results using exactly the same measurement model and methods that NIST would use in calibrating the entire instrument, which is ordinarily not the case.

Contents

8. How should a customer claim traceability to NIST if NIST needs to use two or more of its own standards to calibrate the customer instrument, standard, or artifact?

NIST may use a number of internal standards to calibrate or validate its own measurement process or system. The measurement results with associated uncertainties form the traceability link(s). The customer should claim traceability to the NIST system comprising the individual standards and should indicate who combined the data using what algorithm. Uncertainties should be documented, calculated, and reported accordingly.

Contents

9. Can a customer claim traceability to NIST for measurement results associated with something that NIST cannot calibrate directly?

Yes, under certain circumstances. If well-accepted, scientifically sound and appropriate measurement equipment, practices, and procedures are used; if measurement values and uncertainties are calculated or otherwise established according to well-established protocols; and if the uncertainties are within accepted norms (both low and high) for the measurement application; then the customer's measurement result might be considered traceable to NIST.

As an example, there are many measurement quantities for which NIST does not offer calibration services, but that are derived from a combination of other measurement quantities for which NIST does provide calibration services. Torque is one example. NIST does not offer a calibration service for torque. It does, however, offer services for the component measurement quantities (mass, length, etc.) that are needed to derive torque, according to the definition of torque. By performing the steps necessary to achieve traceability to NIST of the individual component measurement results when making a particular measurement of torque, it is possible to claim traceability of the corresponding measurement result to NIST. The uncertainty of the measurement result must first be calculated (again using a well-established methodology, such as that in NIST Technical Note 1297, Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results) using the uncertainties associated with the individual component measurement quantities. This uncertainty must be at (or above) a realistic level of uncertainty consistent with the sophistication of the measurement model and other practical and established considerations.

As another example, NIST does provide calibration services for voltage, but only at discrete values of voltage. If an organization wants to establish traceability to NIST at other values of voltage, it must develop an interpolation or extrapolation mechanism and protocol for doing this. Additional measurement uncertainties will result. The resulting statement of traceability must incorporate these additional uncertainties, which must again be realistic and within expected norms.

As a third example, NIST may not offer any calibration service or SRM for a particular measurement quantity, but may provide measurement protocols and advice, along with expected norms for levels of uncertainty that can be achieved according to the protocol. Under these circumstances, an organization may again claim traceability of its measurement results to NIST if the protocols (and built-in checks/tests) are followed, and the claimed uncertainties are within the expected norms.

For more on the "Elements of Traceability" please see clause 4 of ILAC-G2: 1994; "Traceability of Measurements" and Reference 1.

Contents

E. Questions about MRAs and Traceability

1. What is the CIPM MRA and what does it have to do with traceability?

The CIPM Mutual Recognition Arrangement (MRA) was drawn up by the International Committee of Weights and Measures (CIPM) under the authority given to it in the Metre Convention, for signature by directors of member National Metrology Institutes (NMIs) [see http://www.bipm.org/en/convention/mra/mra_online.html for the text of the MRA]. The principal objectives of the MRA are to establish through measurement comparisons the degree of equivalence of national measurement standards maintained by NMIs, to provide for the mutual recognition of calibration and measurement certificates issued by NMIs, and to provide a secure technical foundation for wider agreements related to international trade, commerce, and regulatory affairs. The mutual recognition of calibration and measurement certificates requires that each NMI participate in the activities of the International Bureau of Weights and Measures (BIPM) (including key measurement comparisons) and have a suitable way of assuring quality in the results of its measurement services. The results of the key measurement comparisons and specific statements of the calibration and measurement capabilities (CMCs) of each signatory NMI are entered in two MRA databases {originally developed by NIST (http://icdb.nist.gov) and maintained by the Bureau of International Weights and Measures at http://kcdb.bipm.org}.

While NIST recognizes the validity of the other signatories' certificates, such recognition does not mean that measurement results traceable to any other signatory are therefore traceable to NIST. The burden of establishing traceability of its measurement results to NIST, and of supporting an associated claim of traceability, is on the individual NMI providing the service.

Contents

2. If a laboratory establishes traceability of its measurement results to standards maintained by a National Measurement Institute (NMI) that is a signatory to the CIPM MRA, does that mean that that laboratory's measurement results are traceable to standards maintained by other signatory NMIs?

While signatory NMIs (including NIST) recognize the validity of other signatories' measurement and calibration certificates under the MRA, such recognition does not mean that measurement results obtained by one signatory NMI are automatically traceable to stated references developed and maintained by any other signatory NMI. However, users of measurement results, who may be either commercial or regulatory entities, may well decide that sufficient evidence exists under the MRA to provide mutually acceptable traceability of these results to the standards and measurements of two or more participating NMIs. Such evidence may include comparable claims of calibration and measurement capabilities of the NMIs for a particular measurement or calibration service, coupled with satisfactory performance on a key comparison of the same measurement or standard by each of the NMIs.

Contents

3. What are laboratory accreditation MRAs and what do they have to do with traceability?

Laboratory accreditation MRAs are established among accreditation bodies, domestically and internationally, for the purpose of recognizing the equivalence of their respective accreditation systems. To be invited to sign an MRA, each accreditation body must undergo an evaluation by its peers to determine its capability and competence to meet documented requirements for the operation of such bodies. Included is the ability of the accreditation body to accredit laboratories to the requirements of the internationally recognized standard ISO/IEC 17025. The purpose of these MRAs is to provide the means by which users of calibration and testing services can have confidence in the calibration and test reports issued by a laboratory that has been accredited by any of the accreditation body signatories to the MRA. The goals are to reduce or eliminate redundant audits by having one evaluation of a laboratory satisfy the needs of the user community and to have the results of calibrations or tests accepted across borders. By signing the arrangement, each signatory is obligated to promote the acceptance of the results of calibrations or tests conducted by the accredited laboratories of any other signatory to the MRA as being technically equivalent to its own. This does not mean that signatory accreditation bodies accept or promote the acceptance of claims of traceability to sources other than NIST as being equal to traceability to standards maintained by NIST. All calibration and test reports must declare the source of traceability and it is the responsibility of the user to determine which source is suitable for its needs. Other tools, such as the CIPM MRA and the databases resulting from this MRA, are meant to assist the users in making this decision. (See Questions II.E.1 and II.E.2 above)

Contents

4. Because NIST's National Voluntary Laboratory Accreditation Program (NVLAP) is a signatory to multiple MRAs with other accreditation bodies, does that mean NIST stands behind claims of traceability made by any laboratory accredited by any other MRA signatory?

As previously stated, laboratory accreditation, whether conducted by NVLAP or any other recognized accreditation body, is a finding of a laboratory's competence and capability to provide scientifically sound and appropriate measurement services within their scope of accreditation. As a signatory to MRAs operated under the auspices of the National Cooperation for Laboratory Accreditation (NACLA), the Asia-Pacific Laboratory Accreditation Cooperation (APLAC) and the International Laboratory Accreditation Cooperation (ILAC), NVLAP is obligated to promote the acceptance of the results of calibrations or tests conducted by the accredited laboratories of any other signatory to any of these MRAs as being technically equivalent to those provided by NVLAP-accredited laboratories. This does not mean that NVLAP accepts or promotes the acceptance of claims of traceability to sources other than NIST as being equal to traceability to standards maintained by NIST. All calibration and test reports must declare the source of traceability and it is the responsibility of the user to determine which source is suitable for its needs.

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III. Examples of NIST Programs in Traceability

A. Traceability for Personnel Radiation Dosimetry. There are about 2 million workers in the United States whose occupational exposure to ionizing radiation is monitored on a continuing basis. These populations include nuclear power plant workers, radiological personnel in health care, and Department of Defense civilian and military personnel associated with submarines, aircraft carriers, nuclear weapons or other radiological activities. The accuracy of the millions of individual measurements depends on instrument calibrations that are traceable to NIST primary standards for ionizing radiations (primarily calibrations for electrons, x-rays, gamma rays and neutrons). The organizations and communities involved include the NIST Physics Laboratory, the NIST National Voluntary Laboratory Accreditation Program (NVLAP), Battelle Pacific Northwest National Laboratory, the Nuclear Regulatory Commission, and the American National Standards Institute (ANSI) Subcommittee N13.11.

American National Standard for Dosimetry - Personnel Dosimetry Performance – Criteria for Testing, ANSI N13.11, as modified by NVLAP Laboratory Bulletin, Volume 11, No. 1, Dosimetry, Effective Date: January 1995. November 2000 revision under review.

Contents

B. Traceability for Radiopharmaceuticals. There are approximately 37,000 nuclear medicine procedures performed daily in U.S. hospitals and clinics in which radioactively labeled drugs are administered to patients. These are mainly used in the diagnosis of cancer, cardiovascular disease and neurological disorders ranging from stroke patients to Alzheimer's disease. In addition to the diagnostic procedures, there are over 100,000 therapeutic nuclear medicine procedures per year - mainly iodine-131 for thyroid cancer and hyperthyroidism, and new agents for bone palliation for terminal cancer patients. The accuracy of each of these pharmacological administrations depends on transfer instruments used in the manufacturing processes that are traceable to NIST primary standards for radioactivity. The organizations involved include the pharmaceutical manufacturers of North America, under the auspices of the Nuclear Energy Institute, the U.S. Food and Drug Administration, the NIST Physics Laboratory and the NIST Standard Reference Materials Program.

D.B. Golas, NIST Radiopharmaceutical Standard Reference Material and the NEI/NIST Radiopharmaceutical Measurement Assurance Program, Applied Radiation and Isotopes 49, 329 (1998).

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C. Traceability of Calibration Sources for Radioanalytical Instruments. There are over 100 operating nuclear power stations in the U.S. and numerous Department of Energy (DoE) and Department of Defense (DoD) sites that must be monitored for release of radioactive gaseous and liquid effluents. The continuing accuracy of these measurements is a concern to the DOE, DOD and to the Nuclear Regulatory Commission and the Environmental Protection Agency. Radioanalytical instrumentation must be calibrated using radioactive sources that are traceable to the primary radioactivity standards at NIST. Organizations involved include the source manufacturers, the Nuclear Energy Institute, the NIST Physics Laboratory, the NIST Calibration Program, other government agencies and the American National Standards Institute Subcommittee ANSI N42.2.

American National Standard – Traceability of Radioactive Sources to the National Institute of Standards and Technology (NIST) and Associated Instrument Quality Control, ANSI N42.22-1995.

Contents

D. Traceability of Commercially Produced Gas Mixture Standards. NIST, in partnership with the Environmental Protection Agency (EPA) and 10 specialty gas companies established the NIST Traceable Reference Materials Program (NTRM) for gas mixture standards as a means for providing end users with the large volumes of NIST-traceable gas mixture standards needed to implement the "Emissions Trading" provision of the 1990 Clean Air Act. In general, an NTRM is a reference material produced and distributed by a commercial supplier with a well-defined traceability linkage to NIST. This linkage is established via criteria and protocols defined by NIST that are tailored to meet the needs of the metrological community to be served. The production and value-assignment protocols required are based on NIST experience in the production and certification of its own gas mixture SRMs. The integrity of the NTRMs produced is assured by NIST through an active internal quality assurance program that includes NIST analysis of at least 10 % of each NTRM batch and NIST value-assignment of each batch based on NIST and client company measurements.

Franklin R. Guenther, William D. Dorko, Walter R. Miller, and George C. Rhoderick, The NIST Traceable Reference Materials Program for Gas Standards, NIST Special Publication 260-126 (1996).

Contents

E. Traceability of the Optical Absorbance Scale. NIST has produced Standard Reference Materials for calibrating the wavelength scale and verifying the absorbance accuracy of UV/visible chemical spectrophotometers for several decades. The NIST production capacity is rapidly becoming insufficient to meet the demand, and a recently developed NIST Traceable Reference Materials (NTRM) program to leverage NIST measurement capability through the private sector is being adapted to these standards. These NTRMs are produced and distributed by commercial suppliers, but with the active participation of NIST in the testing and value assignment of the standards. The first NTRMs for chemical spectrophotometry will be on the market within the coming year, and will be modeled on NIST SRM 930e and NIST SRM 1930, neutral density glasses (in a cuvette-simulation format) certified at five wavelengths in the visible spectral region and spanning absorbances between 0.3 and 2.0.

The expanded uncertainties for the certified values will be kept close to those of the corresponding NIST standards by frequent intercomparison measurements with the NIST Reference Spectrophotometer in the Analytical Chemistry Division of NIST. The participating laboratories have been accredited for the certification of these materials through the NIST National Voluntary Laboratory Accreditation Program (NVLAP). Other spectrophotometric NTRMs for wavelength calibration and UV absorbance verification are expected to follow.

G.W. Kramer and J.C. Travis, Technical Specifications for Certification of Spectrophotometric NTRMs, NIST Special Publication 260-140 (2000).

NIST Handbook 150-21: NVLAP Chemical Calibration: Certifiers of Spectrophotometric NTRMs [see http://ts.nist.gov/ts/htdocs/210/214/docs/handbook.htm]

Contents

F. Traceability of Ion-Implanted Arsenic in Semiconductor Materials. Ion-implanted standards of known dose are needed to calibrate secondary ion responses for Secondary Ionization Mass Spectrometry (SIMS) in the semiconductor industry. SIMS is relied upon to measure the concentrations and depth profiles of key dopants in silicon, but SIMS measurement results are matrix dependent. A reference material is needed for each element and matrix combination and the comparability of SIMS results when calibrated with reference materials from different sources is not sufficient to meet the needs of the semiconductor community. An accuracy-based transfer standard from NIST enables the industry to transfer technology from one manufacturing site to another, compare experimental data with theoretical process models, and provide the basis for international comparability via ISO (International Organization for Standardization) standards.

A NIST reference method for arsenic in silicon based on Neutron Activation Analysis was developed and critically evaluated. Twenty-nine sources of uncertainty were identified and quantified, of which seven accounted for 98 % of the total uncertainty. This reference technology was transferred to the semiconductor community through certification of SRM 2134, Ion-Implanted Arsenic in Silicon, which has an expanded uncertainty of 0.38 %. The 1999 International Technology Roadmap for Semiconductors (ITRS) calls for improvement in dopant profile concentration measurements from ± 5 % in 1999 to ± 2 % in 2008. These values are to be accomplished with "low systematic error" as well. SRM 2134 meets these requirements for arsenic now, in 2001.

R.R. Greenberg, R.M. Lindstrom, and D.S. Simons, Transferring the Accuracy of NIST Measurements to the Semiconductor Industry, J. Radioanalytical Nuclear Chemistry 245, 57 (2000).

Contents

G. Traceability to the International Temperature Scale of 1990 (ITS-90). The SI defines temperature on the Kelvin Thermodynamic Scale. In practice, temperature is measured on the more easily realized International Temperature Scale of 1990 (ITS-90), which is a close approximation to the Kelvin scale. As custodian of the ITS-90 scale, NIST provides to its customers:

1. a description of the scale, guidelines for its realization and use, and descriptions of how NIST realizes the scale, 2. a broad range of calibration services of contact thermometers, radiation thermometers, fixed-point cells, and associated transfer standards, and 3. fixed-point materials, fixed-point cells, and thermometers as SRMs.

An example of traceability to NIST temperature standards is the Measurement Assurance Program (MAP), as implemented with Standard Platinum Resistance Thermometers in the range - 190° C to 660° C. In a MAP, NIST sends to a customer who realizes the ITS-90 or an approximation to the ITS-90 a set of three SPRTs that have previously been calibrated by NIST on the ITS-90. The customer calibrates the set of SPRTs and then returns the SPRTs to NIST for a final calibration. NIST analyzes the raw data, uncertainty statements, methods of data analysis, methods of realization of the ITS-90, calibration report results and format. A full descriptive report of this analysis is sent to the customer with suggestions for improvement and a quantitative statement of the present level of agreement of the customer calibrations with the NIST calibrations. A MAP is a quantitative test of the customer's ability to calibrate SPRTs and of the validity of the claimed uncertainties of the calibrations. When conducted at regular intervals, a MAP supports the customer's claim of continuous traceability to NIST at a specified uncertainty.

B.W. Mangum and G.T. Furukawa, Guidelines for Realizing the International Temperature Scale of 1990 (ITS-90), NIST Technical Note 1265 (1990).

G.F. Strouse, NIST Measurement Assurance Program For The ITS-90, Test and Calibration Symposium, Arlington, VA, 1994.

Contents

H. Traceability to the Coordinated Universal Time Scale. The international standard for time and frequency metrology is the Coordinated Universal Time Scale (UTC) maintained by the BIPM in Paris, France. Traceability of time and frequency standards is required for the calibration and testing of devices from simple mechanical timers to state-of-the-art atomic oscillators. NIST maintains a real time version of the UTC and offers services that provide high accuracy traceability. The NIST Frequency Measurement and Analysis Service (FMAS) allows users to lease a complete measurement system from NIST. The FMAS includes a GPS receiver, all necessary measurement hardware, and a data line back to NIST. All measurements are made automatically, and are traceable to NIST at an uncertainty of 2×10^{-13} per day. NIST oversees the entire measurement process, and is responsible for both measurements and uncertainty analysis. See http://www.boulder.nist.gov/timefreq/service/fms.htm for a complete description.

M.A. Lombardi, Traceability in Time and Frequency Metrology, NCSL International Conference Session 1B, Charlotte, NC (1999).

Contents

IV. Glossary of Terms

Calibration – set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or reference material, and the corresponding values realized by standards. (International Vocabulary of Basic and General Terms in Metrology (VIM; 1993) definition)

Calibration and measurement certificates – the result of a calibration may be recorded in a document, sometimes called a calibration certificate or a calibration report. Also can refer to a document accompanying a certified reference material (NIST SRM) stating one or more property values and their uncertainties, and confirming that the necessary procedures have been carried out to ensure their validity and traceability. (VIM and ISO Guide 30: Terms and definitions used in connection with reference materials. See also ISO Guide 31: Contents of certificates of reference materials)

Internal measurement assurance program – program of sufficient complexity, within an organization, to provide credibility to the measurement uncertainty and measurement result for which traceability is to be established. An internal measurement assurance program usually involves monitoring the performance (e.g., stability, reproducibility) of the instrument, standard, or measurement system, both before and after it is characterized calibrated, or used to obtain the traceable measurement result.

Laboratory accreditation – procedure by which an authoritative body gives formal recognition that a laboratory is competent to carry out specific tasks. Accreditation does not itself qualify the laboratory to approve any particular product. However, accreditation may be relevant to approval and certification authorities when they decide whether or not to accept data produced by a given laboratory in connection with their own activities. (ISO Guide 58: Calibration and testing laboratory accreditation systems – General requirements for operation and recognition, 1993)

National or international standards – here meaning measurement standards. Standards (national) recognized by a national decision to serve, in a country, as the basis for assigning values to other standards of the quantity concerned; standards (international) recognized by an international agreement to serve internationally as the basis for assigning values to other standards of the quantity concerned. (International Vocabulary of Basic and General Terms in Metrology (VIM; 1993))

NIST Traceable Reference Material (NTRM) - a reference material produced by a commercial supplier with a well-defined traceability to NIST established via criteria and protocols defined and documented by NIST and tailored to meet the needs of the metrological community to be served.

Official NIST program or collaboration – NIST program or collaboration, officially approved by NIST management, in which NIST formally assures or certifies traceability of the results of measurements or values of standards.

Organizations that have authority and responsibility for variously defining, specifying, assuring, or certifying traceability – here meaning any regulatory agency, standards developing organization, accreditation body, trade association or the like, which, by law or mutual agreement, is assigned or takes on authority and responsibility for some aspect of defining, specifying, assuring, or certifying traceability.

Proficiency evaluation materials – homogeneous material or artifact that is used to test and evaluate the measurement performance of different measuring systems for specific tasks

Provider of result (of measurement) or value (of standard) – individual or organization that supplies for use the result of measurement or value of standard for which traceability is being asserted.

Reference material - material or substance one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (International Vocabulary of Basic and General Terms in Metrology (VIM; 1993) and ISO Guide 30:1992)

Result of measurement – value attributed to a measurand, obtained by measurement, where the measurand is the particular quantity subject to measurement and the value of the quantity is the magnitude of the particular quantity, generally expressed as a unit of measurement multiplied by a number.

Standard Reference Materials – certified reference materials (CRMs) issued under the NIST trademark. NIST Standard Reference Materials are characterized using state-of-the-art measurement methods and/or technologies for the determination of chemical composition and/or physical properties. The property values of an SRM are certified by a procedure that establishes traceability to an accurate realization of the unit in which the property values are expressed. Each certified value is accompanied by an uncertainty at a stated level of confidence. SRMs are issued by NIST with a certificate that reports the results of the characterization and indicates the intended use of the material. (See also International Vocabulary of Basic and General Terms in Metrology (VIM; 1993) and ISO Guide 30: 1992).

Standard Reference Data – quantitative information, related to a measurable physical or chemical property of a substance or system of substances of known composition and structure, which is critically evaluated as to its reliability (Standard Reference Data Act, 15 U.S.C. 290 Sec. 2(a)).

Stated reference – here taken to mean "stated reference standard", where: (1) stated here means explicitly set forth in supporting documentation, and (2) a reference standard, which according to the International Vocabulary of Basic and General Terms in Metrology (VIM; 1993), is a standard generally having the highest metrological quality available at a given location or in a given organization, from which measurements there are derived.

Stated uncertainties - uncertainty of measurement that: (1) fulfills the International Vocabulary of Basic and General Terms in Metrology (VIM; 1993) definition as the parameter, associated with the result of a measurement, that characterizes the dispersion of values that could reasonably be attributed to the measurand; (2) is evaluated and expressed according to the general rules given in the ISO Guide to the Expression of Uncertainty in Measurement; and (3) is explicitly set forth in supporting documentation

Test methods – logical sequence of operations, described generically, used in the performance of measurements (International Vocabulary of Basic and General Terms in Metrology (VIM; 1993)) or specified technical procedures for performing a test (ISO Guide 2).

Unbroken chain of comparisons – complete, explicitly described, and documented series of comparisons that successively link the value and uncertainty of the result of a measurement with the values and uncertainties of each of the intermediate reference standards and the highest reference standard to which traceability for the result of measurement is claimed

User of result (of measurement) or value (of standard) - individual or organization that receives for use the result of measurement or value of standard for which traceability is being asserted

Value of a standard - the value attributed to a material measure, measuring instrument, or measuring system intended to define, realize, conserve, or reproduce a unit or one or more values of a quantity to serve as a reference (International Vocabulary of Basic and General

Terms in Metrology (VIM; 1993))

Contents

V. References

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2. B.C. Belanger, Traceability: An Evolving Concept, ASTM Standardization News **8**, 22 (1980).
3. J.M. Cameron and H. Plumb, Traceability with Special Reference to Temperature Measurement, Society of Automotive Engineers, Report 690428, National Air Transportation Meeting (1969).
4. J.M. Cameron, Traceability, Journal of Quality Technology **7**, 193 (1975).
5. E.L. Garner and S.D. Rasberry, What's New in Traceability, ASTM Journal of Testing and Evaluation **21**, 505 (1993).
6. American National Standard for Dosimetry – Personnel Dosimetry Performance – Criteria for Testing, ANSI N13.11-2001.
7. D.B. Golas, NIST Radiopharmaceutical Standard Reference Materials and the NEI/NIST Radiopharmaceutical Measurement Assurance Program, Applied Radiation and Isotopes **49**, 329 (1998).
8. American National Standard – Traceability of Radioactive Sources to the National Institute of Standards and Technology (NIST) and Associated Instrument Quality Control, ANSI N42.22-1995.
9. International Vocabulary of Basic and General Terms in Metrology (VIM), BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML (1993).
10. ISO/IEC Guide 2: Standardization and Related Activities – General Vocabulary (1996).
11. T.E. Gills, S. Dittmann, J.R. Rumble, Jr., C.S. Brickenkamp, G.L. Harris, and N.M. Trahey, NIST Mechanisms for Disseminating Measurements, Journal of Research of the National Institute of Standards and Technology **106**, 315 (2001).
12. Research Triangle Institute (Sheila A. Martin, Michael P. Gallaher, and Alan C. O'Conner), Economic Impact of Standard Reference Materials for Sulfur in Fossil Fuels (Planning Report 00-1), Gaithersburg, MD: National Institute of Standards and Technology (2000).
13. J.P. Cali, T.W. Mears, R.E. Michaelis, W.P. Reed, R.W. Seward, C.L. Stanley, H.T. Yolken, and H.H. Ku, The Role of Standard Reference Materials in Measurement Systems, NBS Monograph 148 (1975).
14. Guide to the Expression of Uncertainty in Measurement (GUM), BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML (1993).
15. GMP 13, Good Measurement Practice for Ensuring Traceability (to be published as a part of the NBS Handbook 145 update).
16. V. R. White, D. F. Alderman, and C. D. Faison, Editors; National Voluntary Laboratory Accreditation Program: Procedures and General Requirements (NIST Handbook 150), July 2001.
17. ILAC Guidance Document Series - G-2, Traceability of Measurements, ILAC (1994).
18. B.N. Taylor and C.E. Kuyatt, Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results, NIST Technical Note 1297 (1994).
19. M.A. Lombardi, Traceability in Time and Frequency Metrology, Session 1B, NCSL International Conference, Charlotte, North Carolina (1999).
20. ISO Guide 30: Terms and Definitions Used in Connection with Reference Materials (1993).
21. ISO Guide 31: Reference Materials – Contents of Certificates and Labels (2000).

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VI. Checklist for Traceability through Calibration

A high-level checklist for traceability through calibration is as follows:

<u>Element #1</u> (*performed at customer facility, responsibility of customer*)

- Identify appropriate transfer instrument/standard/system, based on consultation with referen laboratory
- Set up a measurement assurance program to characterize the transfer instrument/standard/sy establishing measurement assurance charts (indicating values and uncertainties associated w the instrument/standard/system)
- Ship transfer instrument/standard/system to calibration laboratory

<u>Element #2</u> (*performed at reference laboratory, responsibility of reference laboratory*)

- Identify appropriate reference standard that is already part of a measurement assurance prog the reference laboratory (and that can provide measurement results traceable to national prin standards for the quantity in question)
- Perform the calibration of the customer transfer instrument/standard/system, preparing a calibration report with values and corresponding uncertainties
- Ship the transfer instrument/standard/system back to the customer along with the calibration report specifying details about the reference standard

<u>Element #3</u> (*performed at customer facility, responsibility of customer*)

- After unpacking the transfer instrument/standard/system and inspecting for damage, carry o measurements according to the same process and procedures used in the measurement assur program discussed in Element #1
- Analyze the new measurement assurance chart to evaluate the condition of the transfer instrument/standard/system with respect to any change in measurement characteristics (com with prior to being shipped to the reference laboratory)
  (note: use the original values, not the new calibrated values, when making this evaluation)
- Establish the appropriate values and uncertainties to use with the newly-calibrated transfer instrument/standard/system, modifying and annotating the control charts accordingly but continuing the measurement assurance program

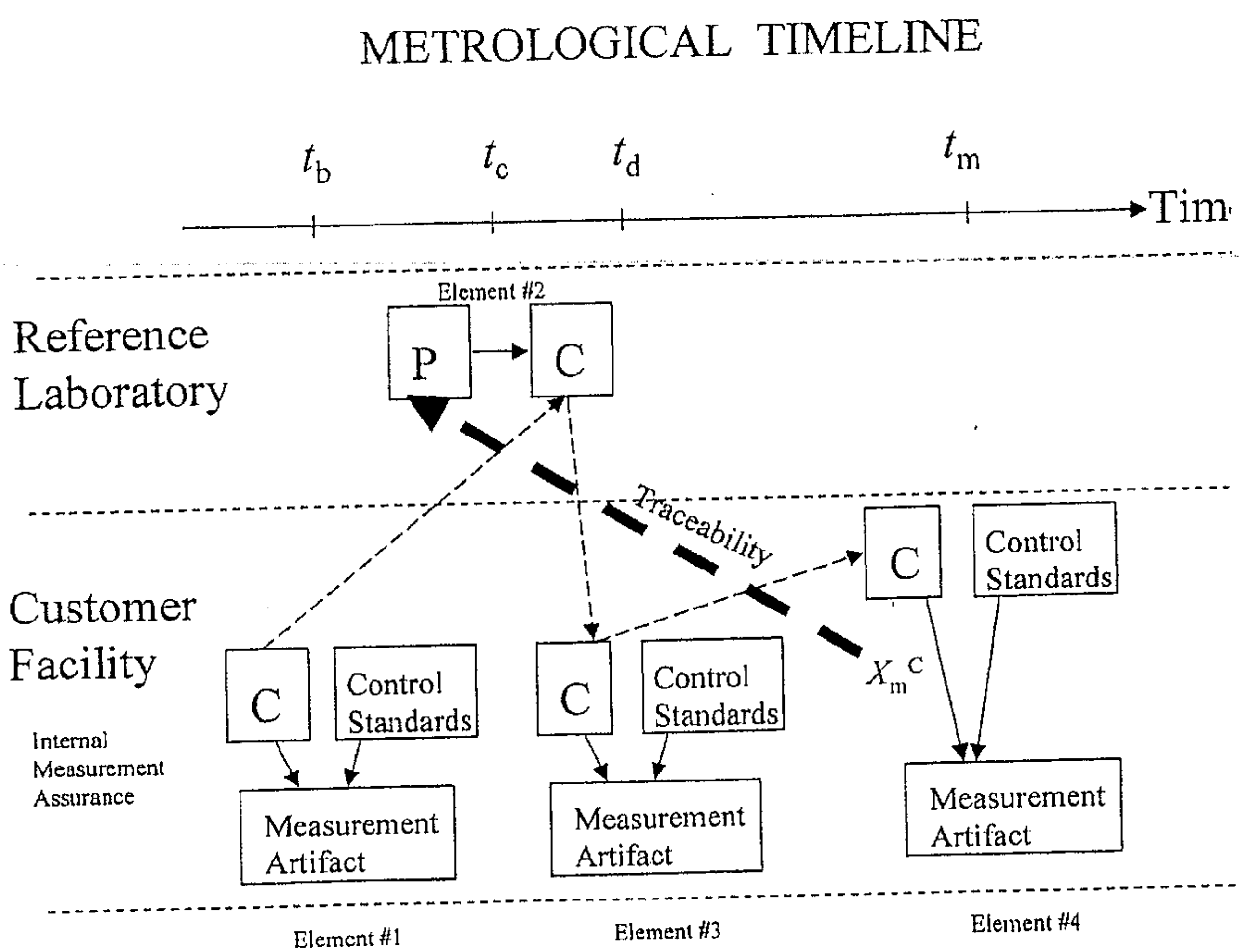
<u>Element #4</u> (*performed at customer facility, responsibility of customer*)

- Just prior to performing a measurement using the transfer instrument/standard/system, characterize it using the measurement assurance program to verify its integrity and performa
- Use the transfer instrument/standard/system to perform a measurement, the result of which i desired to be traceable to the reference standard at the reference laboratory
- Evaluate the uncertainty associated with this measurement result, taking into account the uncertainty stated in the calibration report
- Just after performing the measurement using the transfer instrument/standard/system, re-

characterize it using the same measurement assurance program to re-verify its integrity and performance (giving reassurance that its characteristics and performance during the measure were likely as expected)

- Formally document all of the steps in these four Elements to the degree necessary, dependin; the importance of the particular measurement result, or to the satisfaction of the requiring organization

The Elements in this checklist are depicted schematically in the figure below (see Reference 1):



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Please send comments or questions to traceability@nist.gov

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NIST HOME

NIST is an agency of the U.S. Commerce Department's Technology Administration

Website Technical Contact: TS Webmaster

Web page created: April 16, 2001
modified: February 4, 2004

Datamaster Thermometer Certifications

Location: Tacoma

Technician: Tpr. Denny Stumph

Digital Reference Thermometer: 091803

Digital Reference Thermometer Certified on: 5-01-2003

The following table lists the DataMaster instruments I maintain. Also listed is the date that the simulator thermometer was certified using a digital reference thermometer calibrated by ICL Calibration Labs. The calibration report shows the computed expanded uncertainties and meets NIST requiremnts. The thermometers were certified in accordance with WAC 448-13-035.

Datamaster Serial #	Thermometer Serial #	Location	Date
949184	F94783	FIFE PD	7/28/2003
949189	B20001200	FIRCREST	7/28/2003
949204	B20001198	WSP DISTRICT	7/28/2003
949200	C20001866	PUYALLUP	7/29/2003
949248	B951227	BONNEY LK PD	7/29/2003
949213	C20001697	TACOMA PD	7/30/2003
949215	C20001710	SUMNER	7/30/2003
949217	B20001193	GIG HARBOR	7/30/2003
949219	E953213	SOUTH HILL SO	7/30/2003
949171	B951528	PUYALLUP TRIB	7/31/2003
949193	B20001199	EATONVILLE	8/6/2003
949181	C20001696	MCCHORD	8/7/2003
949209	C20001854	BUCKLEY	8/7/2003
949212	B20001197	LAKEWOOD SO	8/7/2003
921121	B20001194	MT. RAINIER	8/14/2003
949093	B20001203	LOANER	7/28/2003
949270	C20001704	LOANER II	7/28/2003

I certify (declare) under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct (RCW 9A.72.085)

Signature	9-15-3	Tacoma WA.
Signature	Date	Location Signed (city)

Demarre
EXHIBIT NO. 47
9-9-04
M. Green

Datamaster Thermometer Certifications

Location: Vancouver

Technician: Dale M. Johnson

Digital Reference Thermometer Serial # 091802

Digital Reference Thermometer Certified on July 2, 2003

The following table lists the Datamaster instruments I maintain. Also listed is the date that the simulator thermometer was certified using a digital reference thermometer calibrated by ICL Calibration Labs. The calibration report shows the computed expanded uncertainties and meets NIST requirements. The thermometers were certified in accordance with WAC 448-13-035.

Datamaster Serial #	Thermometer Serial #	Location	Date
949113	B951325	Longview PD	9/11/2003
949130	B951246	Klickitat Co Jail	9/15/2003
949262	B951327	Cowlitz Co SO	9/11/2003
949152	B951372	Wooeland PD	9/16/2003
949100	1702	Cowlitz Co Jail	9/11/2003
949170	B951333	White Salmon SO	9/15/2003
949145	C20001710	Camas PD	9/15/2003
949125	B951452	Kelso PD	9/11/2003
949140	B951322	Scale 72	9/16/2003
949165	B951442	Wahkiakum Co Jail	9/16/2003
949259	C20001861	Skamania Co Jail	9/15/2003
949266	C20001863	WSP Vancouver	8/12/2003
949096	B951232	Clark Co Jail	9/8/2003
949072	B951243	Clark Co Jail	9/8/2003
949038	P79480	Battleground PD	9/8/2003

I certify (declare) under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct (RCW 9A.72.085)

Dale M Johnson 10/31/03 VANCOUVER

Signature Date Location Signed (city)

31 July, 2003

To: Hearing Examiners
Department of Licensing

From: Trooper Randolph Vranish

The following table lists the Datamaster instruments I maintain. Also listed is the date that the simulator thermometer was certified using a thermometer calibrated by ICL Calibration Labs. The calibration report clearly shows the computed expanded uncertainties and meets NIST requirements.

DATE	DATAMASTER	SIMULATOR THERMOMETER SERIAL #	REFERENCE THERMOMETER SERIAL #
15 May, 2003	949177	B951923	091800
23 May, 2003	949186	B951370	091800
18 June, 2003	949188	A2000758	091798
26 May, 2003	949190	A2000757	091800
25 June, 2003	949190	A2000757	091798
6 June, 2003	949191	C20001876	091800
19 June, 2003	949191	C20001876	091798
17 May, 2003	949192	B20001106	091800
18 June, 2003	949192	B20001106	091798
22 May, 2003	949194	C20001856	091800
26 June, 2003	949194	C20001856	091798
19 June, 2003	949195	B951436	091798
24 July, 2003	949195	B951436	091798
18 June, 2003	949203	C20001731	091798
19 June, 2003	949205	B95150	091798
27 May, 2003	949208	B2000967	091800
27 June, 2003	949208	B2000967	091798
28 May; 2003	949214	B2000969	091800
18 June, 2003	949214	B2000969	091798
22 May, 2003	949247	B951446	091800
26 June, 2003	949247	B951446	091798
9 June, 2003	949251	B95558	091800
4 June, 2003	949258	B20001104	091800
20 June, 2003	949258	B20001104	091798
3 June, 2003	949269	C20001858	091800
19 June, 2003	949269	C20001858	091798

I certify (declare) under penalty of perjury under the laws of the state of Washington that the foregoing is true and correct. (RCW 9A.72.085.)

Randolph P. Vranish, 831
Trooper, Washington State Patrol

Marysville, Washington
(Place Signed)

1 Aug, 2003
(Date Signed)

Datamaster Thermometer Certifications

Location: Spokane

Technician: Tpr. Brian Bowers

Digital Reference Thermometer: 091796

Digital Reference Thermometer Certified on: 6-17-2003
The following table lists the Datamaster instruments I maintain. Also listed is the date that the simulator thermometer was certified using a digital reference thermometer calibrated by ICL Calibration Labs. The calibration report shows the computed expanded uncertainties and meets NIST requirements. The thermometers were certified in accordance with WAC 448-13-035.

Datamaster Serial #	Thermometer Serial #	Location	Date
949166	A20012528	DEER PARK SO	6/25/2003
949034	G942562	VALLEY SO RIGHT	6/26/2003
949056	G942676	VALLEY SO LEFT	6/26/2003
949167	A20012530	MEDICAL LAKE PD	6/26/2003
949024	E954342	AIRWAY HEIGHTS PD	6/27/2003
949050	B20001116	WSP NORTH	6/27/2003
949131	E953630	CHENEY PD	6/27/2003
949178	B20001117	FAIRCHILD AFB	6/27/2003
949201	C20001729	PSB LEFT	6/27/2003
949202	B951315	PSB RIGHT	6/27/2003
949027	G941429	COLFAX SO	7/1/2003
949062	B20001118	PULLMAN PD	7/1/2003
949053	G942497	DAVENPORT SO	7/3/2003
949173	C20001728	WELLPINIT PD	7/3/2003
949030	B20001119	CHEWELAH PD	7/11/2003
949123	B20001121	COLVILLE SO	7/11/2003
949021	G942498	NEWPORT SO	7/16/2003
949058	B20001122	REPUBLIC SO	7/23/2003

I certify (declare) under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct (RCW 9A.72.085)

B Bowers 10-31-03 SPOKANE WA.

Signature Date Location Signed (city)

August 18, 2003

To: Hearing Examiners
Department Of Licensing

From: Trooper Korthuis-Smith

The following table lists the Datamaster Instruments I maintain. Also listed is the date that the simulator thermometer was certified using a thermometer calibrated by ICL Calibration labs. The calibration report clearly shows the computed expanded uncertainties and meets NIST requirements. The thermometers were certified in accordance with WAC 448-13-035.

DATE	DATAMASTER	SIMULATOR THERMOMETER SERIAL #	REFERENCE THERMOMETER SERIAL #
July 09 2003	949142	B951339	091797
July 09 2003	949168	B20001240	091797
July 09 2003	949150	B951306	091797
July 09 2003	949151	B951351	091797
July 09 2003	949153	A20012493	091797
July 09 2003	949040	B20001244	091797
July 10 2003	949147	B951380	091797
July 10 2003	949164	A20012492	091797
July 10 2003	949163	B951334	091797
July 28 2003	949149	B951376	091797
August 8, 2003	949004	B951377	091797
July 09, 2003	949146	B20001243	091797
July 09, 2003	949148	E954395	091797
August 18, 2003	949134	B951448	091797
August 18, 2003	949169	B20001240	091797

I certify (declare) under penalty of perjury under the laws of the state of Washington that the foregoing is true and correct. (RCW 9A.72.085)

X [signature]

Dwayne Korthuis-Smith, 753 — Tumwater, Washington

Trooper, Washington State Patrol — (Place signed) Date Signed:

Sept 17 2003

Datamaster Thermometer Certifications

Location: King County

Technicians: Tpr. Ken Denton, Tpr. Steve Luce, Tpr. Doug Jones

Digital Reference Thermometer: 091800, 091801

Digital Reference Thermometer Certified on: 3-11-2003

The following table lists the Datamaster instruments I maintain. Also listed is the date that the simulator thermometer was certified using a digital reference thermometer calibrated by ICL Calibration Labs. The calibration report shows the computed expanded uncertainties and meets NIST requirements. The thermometers were certified in accordance with WAC 448-13-035.

Datamaster Serial #	Thermometer Serial #	Location	Certification Date
949277	B20012551	West Seattle	3/19/03
949185	C20001867	Shoreline	5/7/03
949265	B20001112	SPD South	5/13/03
949260	B20001110	SPD Traffic	5/16/03
949229	E953165	Kenmore	5/19/03
949207	C20001877	SPD West	5/20/03
949218	B20001088	SPDN	5/20/03
949224	B951240	SPDE	5/21/03
949275	B20012551	SPD South West	5/29/03
949261	C20001712	Des Moines	6/4/03
949246	A20012537	Mobile DUI Van	6/12/03
949252	C20001719	UWPD	6/16/03
949235	B20001095	Bellevue P.D.	6/19/03
949271	E952379	Federal Way	6/19/03
949187	B20001101	Auburn PD	6/20/03
949236	B20001107	Kent PD	6/20/03
949221	B951328	Snoqualmie	6/24/03
949223	B951916	Mercer Island P.D.	6/24/03
949225	B20001102	Burien SO	6/24/03
949226	B951449	Algona PD	6/24/03
949232	A20012536	Issaquah	6/24/03
940033	B2000976	Sea Tac POS	6/25/03
949263	B20001099	Bothell	6/25/03

949155	B20001093	Vashon Island	6/26/03
949231	B20001094	RJC Kent	6/26/03
949241	B951230	Clyde Hill	6/26/03
949228	B951451	Tukwilla	6/27/03
949216	C20001732	Renton	6/30/03
949242	A2000821	Maple Valley	6/30/03
949256	A20012545	Enumclaw	6/30/03
949211	B20012548	Pier 46 POS	7/2/03
949227	E953003	Redmond	7/7/03
949272	B951920	Kirkland	7/7/03
949274	C20001722	Lk Forest Park	7/8/03

I certify (declare) under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct (RCW 9A.72.085)

10-7-03 SEATTLE

Signature | Date | Location Signed (city)

TPR STEVE LUCE

Datamaster Thermometer Certifications

Location: Kennewick

Technician: Sidney L. Grant

Digital Reference Thermometer: 082709

Digital Reference Thermometer Certified on: 07-11-2003

The following table lists the Datamaster instruments I maintain. Also listed is the date that the simulator thermometer was certified using a digital reference thermometer calibrated by ICL Calibration Labs. The calibration report shows the computed expanded uncertainties and meets NIST requirements. The thermometers were certified in accordance with WAC 448-13-035.

Datamaster Serial #	Thermometer Serial #	Location	Date
949025	B2000-978	Franklin Co Jail	9/16/2003
949020	B2000-1189	Franklin Co Jail	9/16/2003
949044	B95-979	Columbia Co Jail	9/16/2003
949045	B2000-1192	Garfield Co Jail	9/16/2003
921042	B2000-1188	Garfield Co Jail	9/16/2003
949048	F94-866	Asotin Co Jail	9/16/2003
949026	B95-975	Adams Co Jail	9/16/2003
949126	A2000-756	Connell PD	9/16/2003
949049	B2000-1187	Benton Co Jail	9/16/2003
949243	B2000-1191	Benton Co Jail	9/16/2003
921051	B95-977	Benton Co Jail	9/16/2003
949008	B2000-1190	Prosser PD	9/17/2003
949041	B2000-966	Walla Walla Co Jail	9/17/2003
921048	B2000-1185	Walla Walla Co Jail	9/17/2003
949029	B2000-1183	Othello PD	9/18/2003
949019	B95-978	Kennewick WSP	9/18/2003

I certify (declare) under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct (RCW 9A.72.085)

	10-15-2003	Kennewick WA
Signature	Date	Location Signed (city)

DATAMASTER THERMOMETER CERTIFICATIONS

Location: Burlington

Technician: Trooper Judy H. Lewis

Digital Reference Thermometer: 091795 and 091798

Digital Reference Thermometer certified on: 091795 – 06-20-03 & 091798 – 06-10-03

The following table lists the Datamaster instruments I maintain. Also listed is the date that the simulator thermometer installed in the simulator used with each listed Datamaster was certified using a digital thermometer calibrated by ICL Calibration Labs. The calibration report clearly shows the computed expanded uncertainties and meets NIST requirements. The thermometers were certified in accordance with WAC 448-13-035.

DATE	DATAMASTER	SIMULATOR	SIMULATOR THERMOMETER SERIAL #	REFERENCE THERMOMETER SERIAL #
23 June, 2003	949014	G2452	B20001091	091798
23 June, 2003	949067	G5199	B20001089	091798
23 June, 2003	949077	G6854	B20001165	091798
23 June, 2003	949156	G6911	B20001166	091798
23 June, 2003	949179	G5316	B20001164	091798
23 June, 2003	949039	G2435	B20001100	091798
23 June, 2003	949075	G6921	C20001859	091798
23 June, 2003	949103	G7211	B20001090	091798
24 June, 2003	949089	G5346	B20001096	091798
24 June, 2003	949127	G7018	B95980	091798
24 June, 2003	949042	G6700	B20001167	091798
24 June, 2003	949159	G1532	B951234	091798
24 June, 2003	949011	G1765	B951244	091798
24 June, 2003	949174	G7751	C20001878	091798
24 June, 2003	949031	G6909	B20001171	091798
24 June, 2003	949154	G7008	B95970	091798
24 June, 2003	949068	G6910	B20001168	091798
30 June, 2003	949132	G6737	A2000753	091798
30 June, 2003	949032	G2472	B95985	091798
02 July, 2003	949268	G6925	B20001097	091798
05 Aug, 2003	949070	G6923	B20001170	091795
06 Aug, 2003	949144	G2471	B95969	091795

I certify (declare) under penalty of perjury under the laws of the state of Washington that the foregoing is true and correct (RCW 9A.72.085)

Judy H. Lewis

Judy H. Lewis 544
Trooper, Washington State Patrol

Burlington, Washington
(Place signed)

9-16-03
(Date Signed)

September 8, 2003

To: Ms. Tonya Marney
Department of Licensing

From: Ms. Ruth Cramer

The following table lists the DataMaster instruments I maintain. Also listed is the date that the simulator thermometer was certified using a digital reference thermometer calibrated by ICL Calibration Laboratories, Inc. The calibration report shows the computed expanded uncertainties and meets NIST requirements. The thermometers were certified in accordance with WAC 448-13-035.

Digital Reference Thermometer 091797 was certified on April 2, 2003.
Digital Reference Thermometer 302173 was certified on July 28, 2003.

DATAMASTER	LOCATION	SIMULATOR THERMOMETER SERIAL NUMBER	DIGITAL REFERENCE THERMOMETER SERIAL NUMBER	DATE	TIME
949009	Thurston County Jail	B951310	091797	July 8, 2003	09:16 am
949090	Olympia PD	B951304	091797	July 3, 2003	10:15 am
949105	Centralia PD	B951299	091797	June 20, 2003	12:30 pm
949128	Lacey PD	B951241	091797	July 3, 2003	10:40 am
949133	Morton PD	B951324	302173	August 29,2003	10:57 am
949135	Yelm PD	B20001176	091797	July 8, 2003	08:18 am
949180	Ohanapecosh RS	B20001178	302173	August 29, 2003	09:41 am
949198	Steilacoom PD	B20001177	091797	July 7, 2003	04:50 pm
949210	Tenino PD	B20001180	091797	June 20, 2003	01:15 pm
949220	Fort Lewis PMO	B951297	302173	August 21, 2003	11:32 am
949267	Lewis County Jail	B20001179	091797	June 20, 2003	11:59 am

I certify (declare) under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct (RCW 9A.72.085)

Ruth Cramer September 15, 2003 Tumwater, Washington

Signature Date Location Signed (city)

Datamaster Thermometer Certifications

Location: Spokane

Technician: Tpr. Brian Bowers

Digital Reference Thermometer: 091796

Digital Reference Thermometer Certified on: 6-17-2003
The following table lists the Datamaster instruments I maintain. Also listed is the date that the simulator thermometer was certified using a digital reference thermometer calibrated by ICL Calibration Labs. The calibration report shows the computed expanded uncertainties and meets NIST requirements. The thermometers were certified in accordance with WAC 448-13-035.

Datamaster Serial #	Thermometer Serial #	Location	Date
949166	A20012528	DEER PARK SO	6/25/2003
949034	G942562	VALLEY SO RIGHT	6/26/2003
949056	G942676	VALLEY SO LEFT	6/26/2003
949167	A20012530	SPARE	6/26/2003
949024	E954342	AIRWAY HEIGHTS PD	6/27/2003
949050	B20001116	WSP NORTH	6/27/2003
949131	E953630	CHENEY PD	6/27/2003
949178	B20001117	FAIRCHILD AFB	6/27/2003
949201	C20001729	PSB LEFT	6/27/2003
949202	B951315	PSB RIGHT	6/27/2003
949027	G941429	COLFAX SO	7/1/2003
949062	B20001118	PULLMAN PD	7/1/2003
949053	G942497	DAVENPORT SO	7/3/2003
949173	C20001728	WELLPINIT PD	7/3/2003
949030	B20001119	CHEWELAH PD	7/11/2003
949123	B20001121	COLVILLE SO	7/11/2003
949021	G942498	NEWPORT SO	7/16/2003
949058	B20001122	REPUBLIC SO	7/23/2003

I certify (declare) under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct (RCW 9A.72.085)

B Bowers 11/1/03 SPOKANE CO. WA.

Signature Date Location Signed (city)

Datamaster Thermometer Certifications

Location: Yakima

Technician: Trooper Doug Dorich

Digital Reference Thermometer: 091794

Digital Reference Certified on: 4/15/03

Datamaster Serial #	Thermometer Serial #	Location	Date
949018	B20001125	Grandview PD	4/28/2003
949007	B20001126	Yakima Co. Jail	5/26/2003
949199	B20001175	Mattawa PD	6/17/2003
949001	F94853	Cle Elum Scale 53	6/19/2003
949003	F94-863	Kittitas Co. Jail	7/9/2003
949006	B20001113	Yakima Co. Jail	7/17/2003
949254	F94862	Sunnyside PD	8/4/2003
949002	F94861	Yakima WSP	8/18/2003
949010	F94859	Yakima PD	10/20/2003
949013	B20001124	Toppenish PD	10/3/2003
949015	F94857	SPARE	8/6/2003
949278	B20001113	Yakima Co. Jail	12/12/2003
881077	B20001114	Yakima Tribal PD	10/20/2003

I certify (declare) under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct (RCW 9A.72.085)

Signature: ______ Date: 7-6-04 Yakima

Signature | Date | Location Signed (city)

Datamaster Thermometer Certifications

Location: Chelan, Douglas, Grant ,Okanogan Counties

Technician: Jon Martin

Digital Reference Thermometer 091793

Digital Reference Thermometer certified on 08-14-2003

The following table lists the Datamaster instruments I maintain. Also listed is the date that the simulator thermometer was certified using a digital reference thermometer calibrated by ICL Calibration Labs. The calibration report shows the computed expanded uncertainties and meets NIST requirements. The thermometers were certified in accordance with WAC 448-13-035.

Datamaster Serial #	Thermometer Serial #	Location	Certification Date
949017	G942491	Wenatchee (CCSO)	9/22/2003
949022	G942561	Ephrata	10/9/2003
949023	F941079	Moses Lake PD	9/24/2003
949033	G942486	Quincy PD	9/24/2003
949037	F94871	Brewster PD	9/24/2003
949046	G942490	Chelan PD	9/25/2003
949047	B20001158	Twisp PD	10/24/2003
949051	F941071	Grand Coulee PD	9/23/2003
949052	F941074	Royal City PD	10/9/2003
949054	G942556	Okanogan (OCSO)	9/25/2003
949059	G942563	E. Wenatchee PD	9/22/2003
949060	B2000968	Oroville PD	11/26/2003
949065	B20001151	Tonasket PD	11/26/2003
949079	B20001173	Wenatchee (CCSO)	9/22/2003
949085	B20001155	Bridgeport (DCSO)	9/23/2003
949087	B20001157	Omak PD	9/25/2003
949182	B20001156	Nespelem	10/24/2003

I certify (declare) under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct (RCW 9A.72.085)

7-29-04 Wenatchee, WA

Signature Date Location Signed (city)

RECEIVED
AUG 0 1 2004
PM

Washington State Patrol

REQUEST FOR PUBLIC RECORDS

TRACKING NUMBER	DATE OF REQUEST	TIME OF REQUEST
	07/15/04	

REQUESTED BY

Name: GARTH DANO / GARTH DANO & ASSOCIATES

Address: 100 E BROADWAY PO BOX 2149

City, State, ZIP: MOSES LAKE WA 98837 Phone No.: 509-764-8426

REQUESTED INFORMATION

PER CHERYL WILL OBTAIN DATABASE, REPAIR AND MAINTENANCE RECORDS, ETC. ON THE BREATH TEST WEB SITE. E-MAILS.

RECEIVED
JUL 2 6 2004
GARTH DANO & ASSC.

INCIDENT INFORMATION

DATE OF INCIDENT:	TIME OF INCIDENT:	LOCATION (INCLUDE COUNTY):
08/21/02		FRANKLIN

PARTIES INVOLVED #1:	PARTIES INVOLVED #2:
KOELZER	

INVESTIGATING OFFICER:	BADGE NUMBER:	CASE NUMBER:	DATAMASTER NUMBER (IF NEEDED):
			949025

REQUESTER READ AND SIGN:

I understand that if a list of individuals is provided me by the Washington State Patrol, it will neither be used to promote the election of an official or promote or oppose a ballot proposition as prohibited by RCW 42.17.130 nor for commercial purposes or give or provide access to material to others for commercial purposes as prohibited by RCW 42.17.260(9). I further understand that requested records may be redacted in accordance with RCW 42.17.

I understand that I will be charged 15 cents per page (20 or more pages) for all standard letter size copies I desire and that other publications are available at cost. I understand that records will be mailed and/or available once full payment is received by WSP. Any overpayment will not be applied to future requests and will not be refunded.

Personal checks, cashier's checks, or money orders are the only accepted payment methods for public disclosure requests. Cash payments will not be accepted under any circumstances.

REQUESTER'S SIGNATURE

COMPLETED BY WSP RECORDS COORDINATOR

NO. OF COPIES 6 @ $.15	$0.00
PHOTOGRAPHS:	$
AUDIO/VIDEO TAPES:	$
MANUALS:	$
CDs/DISKETTES:	$
SUBTOTAL:	$
POSTAGE:	$0.00
TOTAL DUE:	$N/C

ACKNOWLEDGEMENT OF RELEASE OF RECORDS

DATE OF RELEASE	TIME OF RELEASE
07-22-04	

COMPLETED BY AGENCY RECORDS COORDINATOR

AMOUNT RECEIVED	FUND	AI	PI
$			

RECIPIENT'S SIGNATURE

PUBLIC RECORDS OFFICER SIGNATURE
BREATH TEST PROGRAM

Demarre
EXHIBIT NO. 51
9-9-04
M. Green

3000-372-002 (R 10/03)

EXHIBIT 4

NIST TRACEABILITY DECLARATION

I, Barry K. Logan, declare under penalty of perjury under the laws of the State of Washington that the following is true and correct:

I am the State Toxicologist authorized under RCW 46.61.506 to approve methods for breath alcohol testing within the State of Washington.

As early as March 19, 2003, and in no case later than December 12th, 2003, the simulator solution thermometers used in DataMaster instruments for breath testing in the State of Washington have been tested and certified against thermometers traceable to standards maintained by NIST. The uncertainties have been measured and recorded at each level. They are in compliance with the requirements of NIST traceability. The documents used by the Washington State Patrol to support NIST traceability are public record and may be found at www.breathtest.wsp.wa.gov or at the Washington State Patrol Breath Test Section, 811 E. Roanoke, Seattle, Washington. Additional information can be obtained at (206) 720-3018.

____

Dr. Barry K. Logan, State Toxicologist

Dated: July 13, 2004

Location: Seattle WA (city and state)

To drivers and attorneys: This exhibit will be used for your upcoming DOL hearing, as noted on the enclosed scheduling letter.

Gullberg, Rod (WSP)

From: Nelson, Craig [CNELSON@DOL.WA.GOV]
Sent: Tuesday, July 06, 2004 3:00 PM
To: Gullberg, Rod (WSP)
Cc: Reichert, Robin (WSP); Logan, Barry (WSP); DanPullo, Susan (ATG); Uhl, Erika (ATG); Moran, Linda (ATG); Ann Lange; Barbara Peterson; Bob Mullenix; Brad Dahlquist; Brenda Ellis; Denise Lackey; Derek Caplinger; Doug Myhre; Elizabeth Graham; Ellen Barton; Hank Landis; Irene Haverty; Jennifer Peterson; Jennifer West; Jerry Mitchell; Jim McNew; Kathleen Jouett; Kathleen O'Brien; Kathryn Koehler; Kevin McConnell; Laura Farris; Leonard English; Lori Provoe; Marjorie Gregg; Mary Pat Casey; Michael Corry; Michelle Sherls; Sheila Musgrove; Terry Schuh
Subject: RE: Thermometer Certifications Affidavit

The AG's were working on some language last Friday; I didn't like it for a variety of reasons. One being it didn't follow the exact language of the opinion and I feel that is rather important at this point. Also, the listed uncertainties are found on the Website documentation but it would be virtually impossible to attach that documentation to every hearing. I therefore suggested the following:

> I, Rod Gullberg, under penalty of perjury, declare that the thermometers used in the Datamaster machines used for BAC breathtests in the state of Washington have been tested against thermometers traceable to standards maintained by NIST. The uncertainties have been measured and recorded at each level. The documents used by the Washington State Patrol to support this traceability are public record and may be found at www.breathtest.wsp.wa.gov.

I haven't heard back from them yet.

-----Original Message-----
From: Rod.Gullberg@wsp.wa.gov [mailto:Rod.Gullberg@wsp.wa.gov]
Sent: Tuesday, July 06, 2004 1:27 PM
To: CNELSON@DOL.WA.GOV
Cc: Robin.Reichert@wsp.wa.gov; Barry.Logan@wsp.wa.gov
Subject: Thermometer Certifications Affidavit

Craig

I understand the language on our current Thermometer Certification Affidavit is not appropriate in view of the recent supreme court decision. Did you come up with some proposed language that will be acceptable. We can change the language and get it to our Technicians for immediate completion. Attached you will find our current affidavits.

Thanks

Rod

Gullberg, Rod (WSP)

From: Gullberg, Rod (WSP)

Sent: Monday, July 19, 2004 3:37 PM

To: Logan, Barry (WSP); 'Inglis, Shannon (ATG)'

Subject: RE: Legal Challenge

Barry,

I went through our policy manual and found the following references to thermometers. These have been in place at least since 9/13/2002:

1. Page 2 - Completing Repair Forms - reference is made to completing a repair form if a simulator thermometer is replaced, it mentions recording the serial number of the thermometer
2. Page 6 - QAP Simulator Repair Form - requires recording the thermometer serial number
3. Page 7 of current manual (page 11 of 2002 manual) - Thermometer Certification affidavit - requires recording thermometer serial number and simulator serial number
4. Page 19 of current manual (page 20 of 2002 manual) - records to be kept regarding simulator thermometer certifications
5. Page 31 of current manual (page 32 of 2002 manual) - specifies "Guth Model 34C" simulator and asks that thermometer serial number be recorded.
6. Page 36 of current manual (page 37 of 2002 manual) - Thermometer Certification Protocol - refers to "Guth Model 34C" simulators and "mercury thermometers"

It seems that approval of the Guth Model 34C simulator would include the approval of the mercury-in-glass thermometer which we received with the device. These have been the only type of thermometer ever used with the Guth Model 34C simulator. As we received the simulators, the MIG is the only type capable of being used.

Operator basic and refresher outlines (signed by Dr Logan) refer to ensuring the simulator thermometer is 34 +/- 0.2 C. These outlines were developed and approved with the understanding that only the MIG thermometer was being employed.

In August 2, 2001 Dr Logan filed a purpose statement regarding his reasons for amending WAC 448-13-040. He explains why the range was changed from +/- 0.2 to +/- 0.3. In the explanatory statement he refers to "... the limits of accuracy of the mercury in glass thermometers used in the breath test equipment,...".

A declaration was prepared and signed by Dr Logan on April 11, 2003 in which it states "...the mercury in glass thermometers used in this program,...".

An IOC from Dr Logan dated April 19, 2001 states "The mercury in glass thermometers used in Washington's Breath Test Program are bought from a reputable vendor,... They are the same thermometers used in virtually every other breath test program...".

The Operator Refresher Training Exam asks that operators draw a picture of a thermometer and show a correct temperature. They are expected to draw the mercury in glass thermometer and proper temperature range.

The Operator Basic Outline also asks that the student be shown how to draw a picture of the simulator thermometer for court purposes. This implies only the mercury in glass type thermometer.

At a meeting of the Breath Test Technicians on June 6, 2001, Dr Logan and Sgt Gullberg asked the technicians to perform a simple experiment comparing the digital reference thermometer to the "mercury thermometer". Also mentioned in the meeting notes is "...certifying the glass/mercury thermometers..."

In an email dated July 12, 2001, Dr Logan explains to Dr Wayne Jones our current practice with simulator thermometers. It states in part "...the mercury thermometer is between the 34.1 and 33.9 ...".

Hope this helps.

Rod

Gullberg, Rod (WSP)

From: Inglis, Shannon (ATG) [ShannonI@ATG.WA.GOV]
Sent: Thursday, July 01, 2004 5:32 PM
To: Logan, Barry (WSP); Nelson, Craig
Cc: Reichert, Robin (WSP); Gullberg, Rod (WSP)
Subject: RE: Todays cases -- and it is bad!

This goes to the issue Seattle lost a couple weeks ago. The city argued the new law applies to all cases currently being litigated, the judge agreed, but found that the thermometers hadn't been "approved" prior to June 10 b/c no approving WAC.

-----Original Message-----
From: Barry.Logan@wsp.wa.gov [mailto:Barry.Logan@wsp.wa.gov]
Sent: Thursday, July 01, 2004 3:57 PM
To: Nelson, Craig
Cc: Robin.Reichert@wsp.wa.gov; Rod.Gullberg@wsp.wa.gov; Inglis, Shannon (ATG)
Subject: RE: Todays cases -- and it is bad!

Craig; Why does 448-13-020 need to be retroactive? Is it your interpretation that the change in the law is retroactive?

BKL

-----Original Message-----
From: Nelson, Craig [mailto:CNELSON@DOL.WA.GOV]
Sent: Thursday, July 01, 2004 3:24 PM
To: Reichert, Robin (WSP)
Subject: RE: Todays cases -- and it is bad!

He just fessed up. He said they were both old cases from before the thermometer certificates had been updated with the calibration info (you may recall that E. Washington was the last, I think, to get theirs done). This is still going to be a major headache. In addition to the 200 or so we still have, there is probably another 50-75 that the AG's office have on appeal that will end up getting dumped. Lets see, no seatbelt stops, no DWLS stops, suppression of all pre june 10 tests because 448-13-020 is not retroactive, no prima facie on traceability, etc. You can wave as they go by, but Mirandize them first or it will be interpreted as a stop. Talk about a bad month!

-----Original Message-----
From: Robin.Reichert@wsp.wa.gov [mailto:Robin.Reichert@wsp.wa.gov]
Sent: Thursday, July 01, 2004 3:17 PM
To: CNELSON@DOL.WA.GOV
Subject: RE: Todays cases -- and it is bad!

Derek Caplinger on both cases.

Lieutenant Rob Reichert
Implied Consent Section
811 East Roanoke Street
Seattle, WA 98102
(206) 720-3019

-----Original Message-----
From: Nelson, Craig [mailto:CNELSON@DOL.WA.GOV]
Sent: Thursday, July 01, 2004 3:15 PM
To: Reichert, Robin (WSP)

Subject: RE: Todays cases -- and it is bad!

Yes, it's bad, but not that bad. When this motion began to pick up speed, I had the breath test section send all our reference thermometers to ICL laboratories in Florida. ICL has all the necessary documentation traceable to NIST, and does determine the uncertainties per the NIST protocol so beloved of Dr. Emory.

The techs then went out and certified all their mercury in glass thermometers on the DataMasters. At that point, the breath test section was in compliance with the defense's interpretation of the WAC (the interpretation with which they prevailed today).

Each technician produced a list of the dates at which they met that compliance for each of their instruments, and this occurred sometime between June and September 2003 throughout the state.

These lists are available on the WebDMS site at:

http://breathtest.wsp.wa.gov/SupportDocs/Nist_Traceability/ICL%20Certified%20Thermometer%20Records.pdf

My interpretation, subject to any new motion by the defense, is that any tests after the dates of that post-ICL recertification is a good test under

Please have people contact Rod Gullberg if they have any questions.

BKL

<><><><><><><><><><><><><><><><><><><><><><>
Barry K. Logan Ph.D., DABFT
Washington State Toxicologist
Director, Forensic Laboratory Services Bureau
Washington State Patrol
2203 Airport Way S.
Seattle, WA 98134

Ph: (206) 262 6000
Fx: (206) 262 6018

barry.logan@wsp.wa.gov <><><><><><><><><><><><><><><><><><><><><><><>

To: 'Pam Loginsky'; Jeffrey Jahns; Bailey, Barbara (ATG); Smith-Merkulov, Carol (ATG); Boharski, Jennifer (ATG); Anderson, Jerry (ATG); Samson, John <catherine@wcsap.org>; <wwcatty@wwics.com>
Sent: Thursday, July 01, 2004 8:56 AM
Subject: Re: Todays cases -- and it is bad!

> Does this mean all BACs before June 10, 2004 are suppressed, or is there
> another date we can use?
>
> Jeff
>
> ---
> Jeffrey J. Jahns
> Chief Deputy Prosecuting Attorney
> Kitsap County Prosecutor's Office
> 614 Division Street, MS-35
> Port Orchard, WA 98366
> 360-337-4982; 360-337-4949 Fax

Subject: RE: Todays cases -- and it is bad!

I don't think anybody knew about the case until this morning; I know I didn't. Like I said, I asked everyone to hold off. No "mandate" has been issued by the court so the case is technically not law yet. who issued the orders?

-----Original Message-----
From: Robin.Reichert@wsp.wa.gov [mailto:Robin.Reichert@wsp.wa.gov]
Sent: Thursday, July 01, 2004 3:12 PM
To: Barry.Logan@wsp.wa.gov; CNELSON@DOL.WA.GOV
Subject: RE: Todays cases -- and it is bad!

Craig to follow up on Dr. Logan's e-mail, I also noticed that the 2 dismissals/cases that I reviewed today, the hearings were convened 1-3 weeks before this decision came out (which was yesterday). Is it appropriate for Hearing Officers to take these types of cases under advisement for 2 or 3 weeks before making their decision? It just caught my attention that these cases were ruled on after yesterday's Supreme Court decision.

Thanks for clearing this up for me.

RR

Lieutenant Rob Reichert
Implied Consent Section
811 East Roanoke Street
Seattle, WA 98102
(206) 720-3019

-----Original Message-----
From: Logan, Barry (WSP)
Sent: Thursday, July 01, 2004 2:49 PM
To: Nelson, Craig
Cc: Reichert, Robin (WSP)
Subject: FW: Todays cases -- and it is bad!

Craig; I have seen a couple of dismissals today based on Seattle v Clark-Munoz. I haven't seen the dates of the offense however on these cases, so I want to be sure we are not throwing the baby out with the
bathwater. I believe the examiners need to review the date of the offense, and cross check that with the date of recertification of the simulator thermometers to find out whether we truly have a problem under this decision. See below....

BKL

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Barry K. Logan Ph.D., DABFT
Washington State Toxicologist
Director, Forensic Laboratory Services Bureau
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2203 Airport Way S.
Seattle, WA 98134

Ph: (206) 262 6000
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barry.logan@wsp.wa.gov <><><><><><><><><><><><><><><><><><><><><><><><><>

-----Original Message-----
From: Logan, Barry (WSP)
Sent: Thursday, July 01, 2004 9:44 AM
To: 'Inglis, Shannon (ATG)'
Cc: Gullberg, Rod (WSP)

NOTICE OF CANCELLATION

MIL-STD-45662A
NOTICE 2
February 27, 1995
SUPERSEDING
NOTICE 1
20 January 1995

MILITARY STANDARD

CALIBRATION SYSTEMS REQUIREMENTS

MIL-STD-45662A, dated 1 August 1988, is hereby canceled. Future acquisitions should refer to International Organization for Standards (ISO) 10012-1, "Quality Assurance Requirements for Measuring Equipment", Part 1: "Meteorological Confirmation System for Measuring Equipment"; American National Standards Institute (ANSI)/National Conference of Standards Laboratories (NCSL) Z540-1, "General Requirements for Calibration Laboratories and Measuring and Test Equipment"; or comparable standards as alternatives to MIL-STD-45662A.

(DoD activities may obtain copies of ISO 10012-1 and ANSI/NCSL Z540-1 from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094. The private sector and other Government agencies may purchase copies from the American National Standards Institute (ANSI), 11 West 42nd Street, New York, NY 10036.)

Preparing activity:
Army - MI

Agent:
OSD - SO

(Project QCIC-0003)

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9-9-04
M. Green

THE OFFICIAL CANCELLATION OF MIL-STD-45662A

MIL-STD-45662A
NOTICE 2
February 27, 1995
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Preparing activity:
Army - MT

Agent:
OSD - SO

(Project QCIC-0003)

495

Demarre
EXHIBIT NO. 53
9-9-04
M. Green

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Training Offered

- QS-9000 Overview
- Internal Auditor Training
- Advanced Product Quality Planning (APQP)
- Business Operating System (BOS)
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- Failure Mode Effects Analysis (FMEA)
- Control Plan Methodology (CP)
- Customer Satisfaction
- Lean Systems Workshop
- Six Sigma Greenbelt Training
- Implementation Workshop
- Process Flowcharting Workshop
- Production Part Approval Process (PPAP)
- Strategic Business Planning Workshop
- Statistical Process Control (SPC)
- Measurement Systems Analysis/Gage R & R (MSA)
- Business Operating System (BOS)
- Team Oriented Problem Solving (8D)
- RAB QMS Auditor Training

QS-9000

Quality System Requirements QS-9000 was develop by the Chrysler, Ford, and General Motors Supplier Quality Requirements Task Force. Previously, each company developed their own expectations for supplie quality systems and the corresponding assessment documents. The standard is presently in its third editio

Update #1: The latest version of the Sanctioned Interpretations have come out and are dated July of 2C

Update #2: Under special Agreement with the International Organization for Standardization to allow QS-9000 to continue to use the ISO 9001:1994 standa through December of 2006. Information from the Big 3 on how they will handle 3rd party registrations and the expiration of those registrations will be published in fut interpretations. This information came from the AIAG i April of 2002.

Note: Most QS-9000 companies will have to make the transition to the new International specification ISO/TS 16949.

Update #3: Again from AIAG in April 2002, The requirement of suppliers to be registered to ISO 9001 equivalent by December 31, 2002 is still a requirement and at this time the Task Force has no intension of extending the date.

In 1988, the Purchasing and Supply Vice Presidents c these companies chartered the Task Force to standardize reference manuals, reporting formats, and technical nomenclature. Since then, the Task Force h published a number of standards and reference manuals. These have been well received by the suppl community and their success served to encourage additional efforts.

The standardized manuals are:

- **Production Part Approval Process (PPAI**
- **Statistical Process Control (SPC)**
- **Advanced Product Quality Planning and Control Plan (APQP)**
- **Measurement System Analysis (MSA)**
- **Potential Failure Mode and Effects Analysis (FMEA)**

There are additional publications that support the QS-

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Site Map

About US

- RAB ISO 9000 Transition Auditor Training
- Document Writing

Services Offered

- Initial System Evaluation ("Gap Analysis")
- Documentation Development
- Implementation Assistance and Guidance
- Final System Evaluation ("Dress Rehearsal")
- Hands-on Auditing
- Contract Internal Auditing Program
- Technical Writing

9000 standard. These include:

- **IASG Sanctioned QS-9000 Interpretation**: used to keep the standard up-to-date betwe publications.
- **Quality System Assessment (QSA)**
- **Business Operating Systems (BOS)**

ISO 9001:1994 and its 137 "SHALL" requirements is t underlying base for the QS-9000 requirements. However, the additional requirements of QS-9000 expand the "SHALLS" to a total of 383 requirements th must be addressed by organizations that conduct business with the North American automotive industry.

Intent

The intent of **Quality System Requirements QS-900(** the development of one common fundamental quality system that provides for continuous improvement, emphasizing defect prevention and the reduction of variation and waste in the supply chain.

Applicability

QS-9000 applies to all internal and external supplier si of Production Materials, Production or Service Parts, Heat-treating, Painting, Plating or other Finishing Services directly to OEM customers subscribing to this document.

Outlook

The International Automotive Task Force (IATF) and ISO/TC 176 have introduced a new global standard, ISO/TS 16949, which is expected to replace the QS-9(standard. It is intended that organizations that already have QS-9000 certification will gradually adopt the additional requirements of ISO/TS 16949 and upgrade the certification during regular surveillance audits. Als see ISO/TS 16949.

Contact Eagle Group for more information

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ISO 9004, ISO 9000, OHSAS 18001, OHSAS 18002, 6 α, 6 sigma, Responsible Care 14001; Responsible Care® 14001, Green belt, Responsible Care Management System, RCMS, ISO 19011, ILO-OSH 2001 Guidelines on occupational safety and health management systems, black belt, ISO 10007, COP, Turtle Diagram, Process Audit, Customer Satisfaction, Customer-oriented process, The Automotive Process Approach to Auditing, Ford, GM, DaimlerChrysler, ISO 16949, ISO/TS 16949, 16949, AS 9100, AS9000, 8D, Team Problem Solving, AS9102, AS9103, Lean Manufacturing